



DomPrep Journal

[Subscribe](#)

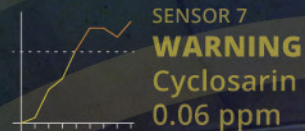
Volume 12 Issue 4, April 2016

INFRASTRUCTURE

Improving the Failing Grade



TOTAL SUPPORT FOR CBRNE THREAT DETECTION



Whether you protect a small municipality, a critical infrastructure facility, or an entire military organization, KD Analytical can help to improve your readiness.

Since 2003, KD Analytical has supported some of the most significant homeland security efforts in the United States and abroad. From threat assessment and system engineering to technical support, maintenance management and training, we offer a comprehensive approach to the sustainment of CBRNE detection and protection programs that reduces downtime and improves detector and responder readiness.

PROTECT™

Real-time CBRNE threat detection, surveillance and crisis management solution for mass transit and building protection.

ReadiTrak™

Web-based equipment maintenance and tech support manager that helps keep critical instruments in peak operating condition.

One Call Support

24/7 matter expertise in maintenance, repair and training for all CBRNE and HazMat equipment and responders.



Business Office

P.O. Box 810
Severna Park, MD 21146 USA
www.DomesticPreparedness.com
(410) 518-6900

Staff

Martin Masiuk
Founder & Publisher
mmasuk@domprep.com

James D. Hessman
Editor Emeritus

Catherine Feinman
Editor-in-Chief
cfeinman@domprep.com

Carole Parker
Manager, Integrated Media
cparker@domprep.com

Advertisers in This Issue:

American Military University

BioFire Defense

FLIR Systems Inc.

64th Annual IAEM Conference &
EMEX

International Hazardous Materials
Response Teams Conference

KD Analytical

National Homeland Security
Conference

PROENGIN Inc.

© Copyright 2016, by IMR Group Inc.; reproduction of any part of this publication without express written permission is strictly prohibited.

DomPrep Journal is electronically delivered by the IMR Group Inc., P.O. Box 810, Severna Park, MD 21146, USA; phone: 410-518-6900; email: subscriber@domprep.com; also available at www.DomPrep.com

Articles are written by professional practitioners in homeland security, domestic preparedness, and related fields. Manuscripts are original work, previously unpublished, and not simultaneously submitted to another publisher. Text is the opinion of the author; publisher holds no liability for their use or interpretation.



Featured in This Issue

Improving the Grade for Critical Infrastructure
By Catherine L. Feinman & Joe D. Manous5

Five Myths – The Cost of Resilience
By Dana Goward11

Emergency Services/Critical Infrastructure Analysis
Methodology
By David Flanigan & Steven Taylor13

Bending the Cost Curve Through Better Design
By David J. Kaufman19

Critical Infrastructure & Strategic Assessment
By David L. Wegner & Sheri Tickner23

Water Sector Resilience & Redundancy
By Steven E. Bieber & Pamela P. Kenel27

Rising Sea Level – A Stealth Threat
By John Englander30

Replacing Aged Infrastructure: The Bundled Bridges
Approach
By Thomas Clark35

U.S. Response to Outbreaks of Avian Influenza
By Gary A. Flory38

Revisiting PROTECT
By Ian Schaefer43

Lockdown at Washington College
By Rodrigo (Roddy) Moscoso46

The Complexity of Credible Coverage
By The Center for Public Safety Innovation48

Active Shooter – When Lock Down Is Not Enough
By Rodney E. Andreasen49

About the Cover: Critical infrastructure is integrated into daily life through roadways, bridges, electricity, water, emergency services, communication, and so much more. A breakdown in any one of these infrastructures could cause catastrophic failure in others. Skylines of cities like San Francisco show how interconnected these infrastructure networks can be. (Source: [©iStockphoto/narvikk](#))

EMERGENCY MANAGEMENT & LEADERSHIP

UNDERGRADUATE AND GRADUATE CERTIFICATES

Developed in partnership with key professional training organizations,
American Military University offers public safety leaders:

- Support through scholarship programs
- Cohort class registration options
- Financial incentives available for select partnerships

TAKE THE NEXT STEP TOWARD YOUR LEADERSHIP GOALS.
LEARN MORE TODAY AT PUBLICSAFETYATAMU.COM/DPJ



Improving the Grade for Critical Infrastructure

By Catherine L. Feinman & Joe D. Manous Jr.

All infrastructure is not the same. Across disciplinary sectors, agencies and organizations must identify the key elements necessary to ensure “a system” (e.g., community) has a minimum level of resilience, as a system is only as strong as the weakest link. The challenges of cross-cutting issues and limited resources for which disciplinary sectors compete, compounds the challenges. On 9 March 2016, DomPrep hosted a roundtable discussion in Arlington, Virginia, to address “Critical Infrastructure – A Failing Grade.”



This article summarizes that discussion, which included 27 subject matter experts from various sectors. Many [reports](#) address the status of critical infrastructure (CI) readiness, with these assessments reporting below par or failing grades. As a result, much of the U.S. infrastructure does not provide an appropriate level of resilience in the face of natural, human-caused, or technological disasters. Complicating the process of finding solutions to these challenges, infrastructure planning, design, operation, and maintenance are often siloed in responsibility, philosophy of design, and funding – though the infrastructure remains functionally interrelated to users. An added complication is that the response planning to disasters often follows the construction of infrastructure. As such, the purpose of the roundtable was to: (a) explore the intersections in the planning, design, operation, maintenance, and funding of infrastructure; (b) discuss commonly missed opportunities to better align infrastructure efforts; and (c) brainstorm opportunities to provide increased synergy in planning a “system” of infrastructure and disaster response actions.

Relationship Between Funding & Resilience

The discussion began with the question, “Is lack of funding the primary issue preventing the existence of robust and resilient infrastructure at the community or regional level?” Although funding is always a concern, there was consensus that a lack of appreciation for the risks and consequences to both human life and property loss associated with infrastructure resilience limits the emphasis by stakeholders and will of decision makers to provide funding. Participants made it clear that funding is a symptom, but the underlying problem is the public’s ability to appreciate the existing infrastructure situation. In addition, at the federal level, agencies are still being tasked with doing more with fewer resources, so funding is a great concern from that perspective. The key problem is that the need for resilience has not effectively been conveyed to policy makers, which has resulted in a lack of coherent policy, wise investment decisions, development of best practices, and consistent approaches to risk analysis.

There is a need to change the message to change the culture. Traditionally, there has been significant reliance on the government to “save the day.” However, it is time to encourage communities to take responsibility for building resilience into their emergency plans. Part of this “more effective” communication is the strengthening of social networks. By knowing what motivates human behavior, emergency planners can create messages that resonate with stakeholders. This may help form agreements on where to invest dollars and assets, and identify the probability and consequences of various types of incidents.

Where the Responsibility Lies

With crises being inherently local, the majority of CI being in the private sector, and everyone depending on the nation’s infrastructure – determining who holds responsibility for CI maintenance can be a challenge. After 9/11, some policy makers pushed to federalize the nation’s CI, but there are roadblocks to this way of thinking. For example, money cannot go directly to CI within the private sector, but there also is not enough money available at the federal level to meet all CI demands. As a result, one participant described it as creating a nation of “heroin addicts,” where communities are given enough money to launch the action, but not enough to sustain the initiatives.

Policy makers need to start looking at the dependencies – for example, losing water or electricity is also a major loss for a state’s economy – and getting the message out to community members that resilience is directly linked to both the immediate protection of human life and long-term economic vitality of a community. Engineers and designers must imagine the unimaginable and each community stakeholder has a critical role in addressing infrastructure issues. As such, emergency planners must collectively reshape the message to include all stakeholders, which should (but often does not) include customers of the infrastructure – for example, consumers of electrical power, water, and transportation routes.

People, policies, processes, technologies, and regulatory enforcement together would enable communities to rebuild resilient infrastructure. Then, there is the question about whether it is beneficial to rebuild at all. Unfortunately, disincentives exist that could promote waiting until after an incident occurs rather than spending money on an uncertain future event. Changing this incentive model requires building networks that drive good decisions. Insurance companies are key by not covering certain types of incidents such as flooding within the 100-year flood plain, which in turn forces people to rethink their rebuilding efforts once their properties are damaged or destroyed.

When considering the interdependencies, it is important to remember the horizontal as well as the vertical environments. This means that, beyond vertical supply chains, there may be horizontal interdependencies that are sometimes overlooked – for example, cyber issues cut across CI sectors. According to one roundtable participant, the power industry is not focused on cybersecurity, not because it is not worried about such issues, but because it has many other responsibilities and pressures to manage daily. The creation of an umbrella

resilience plan could reach across sectors, assuming these sectors are willing to hold productive conversations that ensure protection of sensitive information. In any case, a fiscal model that shows profits and risks is needed to help stakeholders visualize the benefits gained by increased infrastructure resilience.

Gaps

An imbalance exists with regard to regulation of CI – ranging from self-regulation in some industries to heavy government regulation in others. Regulatory change could make a difference, but it is difficult because of technical, economic, and business challenges. In the water and wastewater sector, investment for resilience is always competing with regulatory requirements and environmental concerns, which is particularly challenging because of mixed messages from the federal government – for example, issues related to the reality of climate change.

Then, there is the challenge of “selling” the concept of CI resilience and maintenance. For example, to receive adequate funding, emergency services agencies such as law enforcement need to sell the idea of nothing happening. When nothing happens, it could be a direct result of effective preventive measures and resilience investments. As these agencies plan now for budgets that will be implemented in two years, they may have difficulty getting the funding and resources they need to maintain the same level of resilience.

“Critical infrastructure protection is not an ‘all or nothing’ venture. Even a little action would reduce the amount of time and money needed to be resilient.”

Another gap exists in the planning processes, which may be different for each agency or sector. Probabilities, risk assessments (levels of risk from various perspectives), and reliable intelligence could help identify threats and develop consequence-based models to help stakeholders determine what could happen (costs, down time, and other consequences) if they lose a building, power, etc. An evaluation of community or regional resilience is often an aggregate of resilience assessments within each of the sectors of law enforcement, medical response, fire protection, transportation, energy, and water. However, the resilience of a community is limited by the least resilient of these sectors – that is, the weakest link. It is essential for design professionals and practitioners across various sectors to identify the “system weak link” to properly assess community resilience.

Finally, there is a gap in what motivates change. One participant noted that higher impact threats, such as Hurricane Katrina, may not motivate communities to take action because they expect others will come to their aid. Although people do build in resilience after they see how much a disaster affects their lives, the areas that are not affected do not tend to

change. For example, the areas directly affected by Hurricane Sandy are generally rebuilding to a better state of flood protection, but surrounding areas, not receiving storm damage assistance, remain the same.

Solutions

As discussed during the roundtable, the ongoing Flint Water Plant crisis in Michigan is not a catastrophic event, but it is a catastrophic failure and a reminder that resilience is related to chronic as well as acute events. Good planning, political will, and local community leadership help to drive resilience as has been demonstrated in multiple case studies. For example: (a) a couple years ago, Boston, Massachusetts, began an aggressive building code plan for sea-level rise and other major catastrophes; and (b) Vermont, New Hampshire, and Maine use the same methodology to measure assets and bundle bridge contracts. It is important to be able to build not to the standards that something was, but to what it could be.

A holistic approach to CI resilience that places less emphasis on funding and more on leadership is needed at all levels. Agencies like the U.S. Army Corps of Engineers and directives like Presidential Policy Directive 8 (PPD-8) are increasing resilience into their processes, but more needs to be done – perhaps, as participants suggested, it is time for a National Resilience Act that helps to:

- Identify “pain points” such as water, information technology security, and other areas wrapped around quality of life, quality of service, and the economy;
- Share information from CI owners about potential failures;
- Oversee and define an analytical framework by the federal government;
- Unify efforts to increase cost-effectiveness and reinvest the savings – for example, transportation planning in the United States for road, rail, waterborne, and air travel, which is often planned and funded separately;
- Encourage tangible actions from design professionals, practitioners, and academia to develop new – and retrofit existing – infrastructure;
- Plan with a regional, multidiscipline, and forward-thinking approach;
- Shift from focusing on the risk to or impact on the infrastructure, to a focus on the risk to and impact on the nation;
- Plan and exercise (tabletop or full-scale) for long-term power outages;
- Insert annexes into emergency plans to address high-impact threats;
- Promote operator-to-operator discussion to approach how to restore operations;
- Change university-level education and practitioner training to better prepare design professionals, and other graduates associated with the development of “adequately resilient” infrastructure, to meet the challenges of today;

- Develop information-sharing protocols to share sensitive information and analysis to deal with real choices;
- Create models that overcome the focus of attention on the day-to-day tasks that may overshadow the big picture;
- Recruit experienced people on the code-writing committees to write in resilience and enhanced operability and sustainability as codes and standards change;
- Collaborate with economies of scale for data interoperability between jurisdictions – for example, cost savings associated with resource sharing; and
- Link local priorities with national issues to align strategic life-and-death issues.

Society’s ability to maximize efficiency by centralizing its infrastructure has resulted in too many dependencies. However, as one participant emphasized, CI protection is not an “all or nothing” venture. Even a little action would reduce the amount of time and money needed to be resilient. Given that much of the United States – and the world in general – has infrastructure in place, the integration of infrastructure both within and across infrastructure sectors cannot be destined to always be a series of “Band-Aids.” It is time to look for a feasible systems-based approach. Given that monetary funding is always a fundamental limitation in infrastructure development, within and across sectors, actions must go beyond funding to force, coerce, or incentivize better integration and development of adequately resilient infrastructure.

In This Issue

Dana Goward leads this issue of the *DomPrep Journal* by addressing five common myths about the cost of resilience. CI will fail, but protecting it does not need to be out of reach. David Flanigan, Steven Taylor, and John Contestabile then introduce a new methodology that analyzes the interconnectedness of CI between sectors.

Of course, covering the cost of fixing or rebuilding infrastructure can be a challenge. David Kaufman and Thomas Clark each offer an article that addresses this challenge with possible solutions such as hazard-risk assessments, building codes, and economies of scale. Partnerships are another key factor in fortifying the aging CI, as discussed by David Wegner and Sheri Tickner and demonstrated in National Capital Region water supply as described by Steven Bieber and Pamela Kenel.

However, before any costs can be planned and actions implemented, the threats and levels of risk must first be identified and accurately conveyed. John Englander, for example, emphasizes the risks associated with rising sea levels, but such long-term planning efforts are often not included in resilience plans. Similarly, Gary Flory describes how the magnitude

of incidents such as widespread influenza outbreaks in animals could create significant risk to humans if the animal remains are not properly managed. In addition to biological threats, chemical, radiological, nuclear, and explosive threats must also be detected as soon as possible. Ian Schaefer shares existing technology that could be expanded for broader use to better protect communities from such threats.

Rounding out the issue is content related to law enforcement issues. One case study by Rodrigo Moscoso describes the decision to lockdown Washington College after careful consideration of active-shooter risk versus student safety. However, lockdown is not always the best option. Rodney Andreasen describes how using citizens as force multipliers can help make communities more resilient in a world where such attacks are growing in frequency. Media can be another force multiplier for conveying risk, sharing information, and building resilience, but relationships such as the ones being built at the Center for Public Safety Innovation must be in place before the incident.

A special thanks goes to all the roundtable participants and sponsors who contributed to this edition of the DomPrep Journal, including:

Mark Adamchik and Al Piombo, United States Park Police; Steven Bieber and Chris Ryan, Metropolitan Washington Council of Governments; Marko Bourne and Gary Leatherman, Booz Allen Hamilton; Jerry Brashear, The Brashear Group LLC; Thomas Clark, Parsons; John Contestabile, Johns Hopkins University Applied Physics Laboratory; Robin Frazier, Carroll County Commissioner; Matthew Gabry and Majoraca Weber, Homeland Security and Emergency Management Agency; Sarah Gambill, U.S. Department of Homeland Security Office of Infrastructure Protection; Dana Goward, Resilient Navigation & Timing Foundation; Brandon Graham, Washington Metropolitan Area Transit Authority; David Kaufman, CNA Safety and Security; Sandra Knight, Center for Disaster Resilience; Thomas Lockwood, Formerly U.S. Department of Homeland Security; Chuck Manto, InfraGard (EMP-SIG); Renee Parker, AFG Group; Glenn Previtera, AECOM; Valerie Reed and Bill Scott, ABS Consulting; Mark Reuther, PROENGIN Inc.; Andrew Roszak, Child Care Aware of America; Timothy Stickler and Erica Wolfkill, KD Analytical; Dave Wegner, Jacobs Engineering; Kelly Woods-Vaughn, InfraGard National Members Alliance and Catalyst Partners.

Catherine Feinman joined Team DomPrep in January 2010. As the editor-in-chief, she works with subject matter experts, advisors, and other contributors to build and create relevant content. With more than 25 years of experience in publishing, she heads the DomPrep Advisory Committee to facilitate new and unique content for today's emergency preparedness and resilience professionals. She also holds various volunteer positions, including emergency medical technician, firefighter, and member of the Media Advisory Panel of EMP SIG (InfraGard National Members Alliance).

Joe D. Manous Jr., P.E., Ph.D., D.WRE, is as a water resources engineer and manager of international activities for the Institute for Water Resources, U.S. Army Corps of Engineers. He specializes in the areas of water resources and environmental security issues associated with water. He is active in the American Society of Civil Engineers, Society of American Military Engineers' Infrastructure Security Partnership Council, and the National Institute for Engineering Ethics, and has worked on a variety of infrastructure, professional development, and college outreach initiatives. Previously, he served as an academy professor at the United States Military Academy at West Point, where he taught courses in environmental engineering, water resources, and environmental security. He is currently an adjunct professor at George Mason University, teaching courses in water resources and engineering economics.

Five Myths – The Cost of Resilience

By Dana Goward

Roads crumble, bridges fall. It is not that the United States cannot maintain, improve, and build more infrastructure. It is that so many people believe it is too difficult because of these myths. The myths have to be debunked to allow new ways of thinking.



Much of the media and political handwringing about the United States' seeming inability to maintain resilient infrastructure is based on false assumptions, which allow industry and political leaders to shrug off responsibility and create a cynical public that sees no alternative to continued deterioration and lack of preparedness. These false assumptions, these myths, need to be debunked so the nation can think and act anew.

Myth 1: The Government Does Not Have Enough Money – Part I

Government is about leadership. Sometimes this includes spending money. But many of governments' most effective, successful, (and therefore little-known) programs involve very little or no money and a lot of leadership. Leadership through good policy is often codified in best practices, standards, and regulations. The nation's electrical grid is a good example. Governments set standards, but the system is built, operated, and expanded with nongovernment funds. Admittedly, many question whether the standards that have been set provide the needed resilience. If they do not, that is because of leadership issues, not a lack of government funds.

Myth 2: The Government Does Not Have Enough Money – Part II

Sometimes it is appropriate or necessary for citizens to devote some of their common funds (government money) to a particular effort. After all, if a project must be done, then citizens should be willing to "put some of their money where their mouths are." In most cases, though, government is not the best choice for building and operating infrastructure, and does not need to pay the whole bill. Public-private partnerships have successfully leveraged private capital, efficiency, and innovation for a wide variety of infrastructure projects from housing to highways. Sometimes the government just contributes idle property or equipment, sometimes it agrees to purchase services provided by the infrastructure. Each case is unique.

When the notorious thief Willie Sutton was asked why he robbed banks, he famously replied, "Because that's where the money is." Despite a huge federal budget, most U.S. money is still in the hands of the commercial and private sectors. Americans should go where the money is for building and maintaining infrastructure.

Myth 3: The Government Does Not Have Enough Money – Part III

In government, when an issue is important enough, there is always enough money. The federal budget is measured in trillions of dollars and many states in tens of billions.

If money is really needed, it is often a matter of making tradeoffs (again a leadership issue). The challenge at all levels for infrastructure projects, though, is communicating an issue or project's importance. Engineers and technologists often speak in data and numbers, while policy makers tend to communicate with stories and examples. The key to prioritizing infrastructure is using good data to create compelling narratives so needs can be prioritized properly.

Citizens also have the option of pooling more of their money for the common good through user fees or taxes. Perhaps the nation has been underpaying for infrastructure and services for decades. It could be time to step up and "make things right." Stealing from the next generation would be shameful.

Myth 4: Infrastructure Is an Expense

To many people, this myth seems to be an obvious truth. But there is a profound difference between "expenses" and "investments," whether in personal life, business, or government. Good infrastructure projects are investments that pay back dividends every day. Paying for infrastructure must not be thought of in the same category as day-to-day expenses. Most businesses have capital budgets to help them make the distinction between expense and investment. So too should all governments.

Myth 5: The Cost of Resilience to Those Who Provide Infrastructure & Critical Services Has to Be Considered

This is probably the worst of the myths. What must be considered instead is the ultimate cost of non-resilient infrastructures. Those who provide essential infrastructure and services do so by public license. A license is granted to a business because it is in the best interest of the public. Allowing businesses to operate in a way that is not in the public's interest simply does not make sense. If resilience requirements are applied equally to all, none will be at a competitive disadvantage. If the cost of some infrastructure services increase, citizens should be pleased that the true cost of the service is being paid and is helping ensure the nation is getting what it really needs.

Summary

Americans have been thinking about paying for infrastructure the same way they think about paying for a dinner out on Saturday night. However, infrastructure affects everyone, and pays everyone back, directly or indirectly, every day – and there is always one or more source of funds for that. It is time to change the thinking and put infrastructure at the top of the list, instead of the bottom.

Dana A. Goward is president of the Resilient Navigation and Timing Foundation, chairman of the Association for Rescue at Sea, and a retired Coast Guard captain. He also is retired from the federal Senior Executive Service.

Emergency Services/Critical Infrastructure Analysis Methodology

By David Flanigan & Steven Taylor

The nation's critical infrastructure – loosely defined as the fundamental facilities, structures, and systems necessary for the basic functioning of daily life – is comprised of diverse components controlled and managed by a mixture of private sector and government organizations with varying levels of responsibility. Understanding the interconnectedness between sectors is key.



Emergency service providers have well-defined missions that require trained personnel operating specialized tools and equipment that requires the services of critical infrastructure (CI) for execution. However, the relationships within and between these CI sectors are not always well understood. This article proposes a methodology to understand this “interconnectedness” within and between sectors by: (a) bounding the problem; (b) describing the functional interdependencies between CI sectors; and (c) providing a means to evaluate the effects of a disturbance. The insights to be gained from this methodology and analysis may allow decision makers to identify areas for future investigation or investment leading to increased capability and resilience.

Define the Analysis Boundary & Scope

To begin, stakeholders and the boundaries of their problems must be identified. The emergency services CI sector is divided into autonomous organizations with individual missions. In addition to being classified as a “critical infrastructure sector,” these organizations are increasingly interdependent with other CI sectors in order to successfully execute their own missions.

Using the U.S. Department of Homeland Security’s CI definitions, the stakeholders for the emergency services sector are: emergency medical services, fire and rescue, emergency management, and law enforcement. These entities – such as a local police department – have well-defined jurisdictional areas within which they operate on a day-to-day basis. Other sectors have much less well-defined boundaries. For example, the electricity grid and the transportation network extend across jurisdictional boundaries. To conduct the analysis, it is important for stakeholders to agree to a common boundary within which the analysis will occur.

Once the boundary of the analysis is established, the stakeholders must establish the service that is required, from whom it must be obtained, and to whom it must be delivered. Each of the emergency services sector agencies have their own specific mission and objectives, but will rely on common CI sectors – for example, the transportation, energy, water, and

communications sectors. For instance, the emergency medical services may be interested in the effects that a loss in communications would have on their ability to deliver service to their jurisdictions (perhaps an entire county).

Finally, it is necessary to depict and quantify the nature of CI inputs to the various emergency services. In other words, the fire service has fire stations wherein apparatus is stationed (nodes) and requires roads (links) necessary to respond to a call for service. With the above information in hand, an analyst may begin to develop a context diagram that shows the entities, the boundaries of the system, and the interactions or interdependencies of that system. Subsequently, the following must be determined: what the analysis questions are; what the desired output of the systems is; and what type of evaluation the stakeholders desire.

Develop the Logical & Functional Model of the Problem

The second step is to identify the types of functions or activities each of the stakeholders must execute, and the interfaces used in support of the emergency services' mission objectives. In a simplified example, the police department receives a call for service. Responding to this

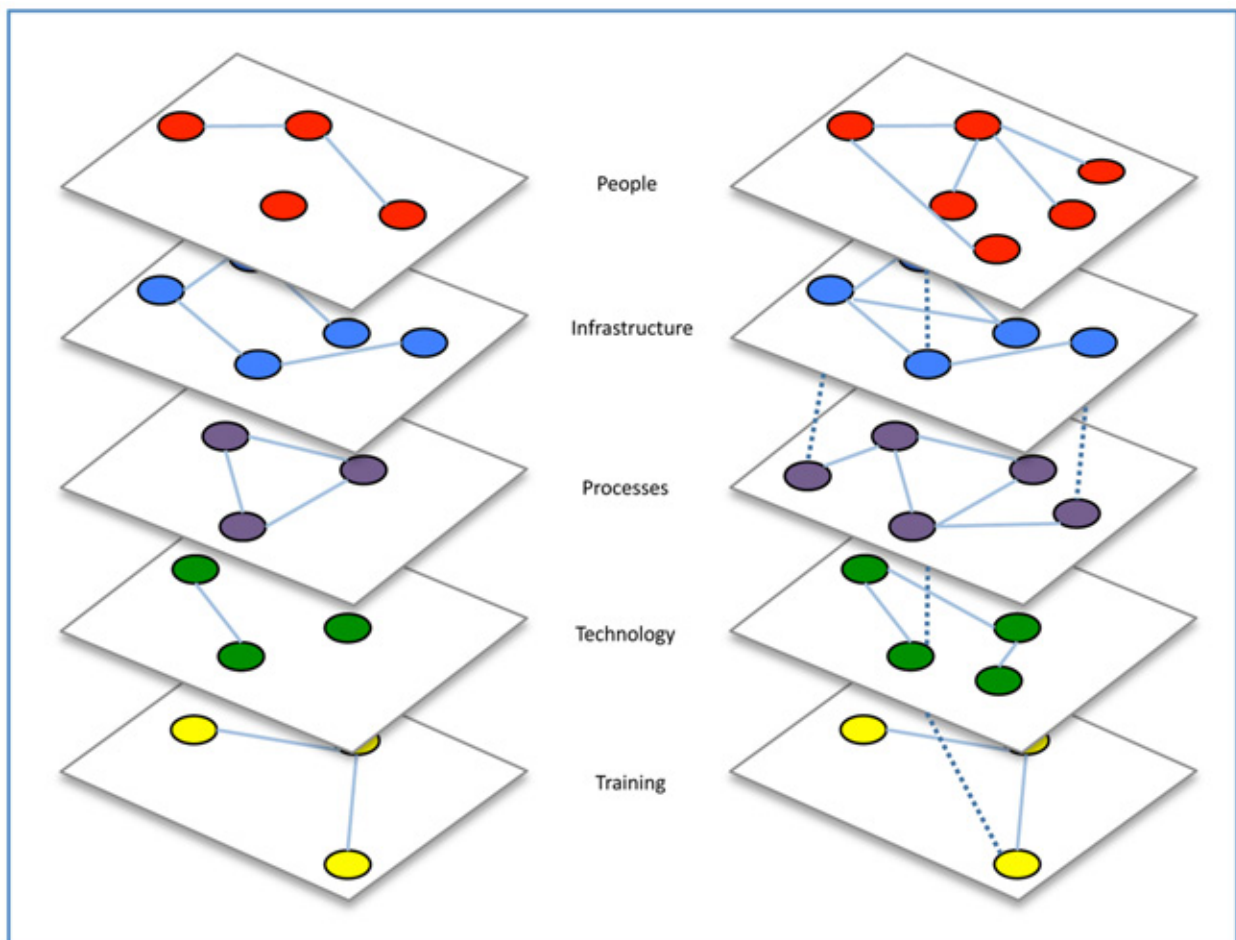


Figure 1. Preliminary Concept Model.

call for service requires that services from the communications, energy, and transportation CI sectors are available. In this example, command and control requires communications services, fuel and electricity are supplied through energy services, and surface roads are available through the transportation sector. Without these CI sectors, law enforcement may not be able to respond to their entire jurisdiction (e.g., due to blocked roads), may have to re-route (causing inefficiency), or use alternate communication means (preventing timely updates to their command and control). Compounding the issue is that the communications and transportation sectors are depending on the availability of the energy sector as well.

The information required to execute the analysis must be obtained from the stakeholders; walking through illustrative scenarios is frequently useful in gathering this type of information. Typically, questions such as those that follow, are used in conjunction with the scenario:

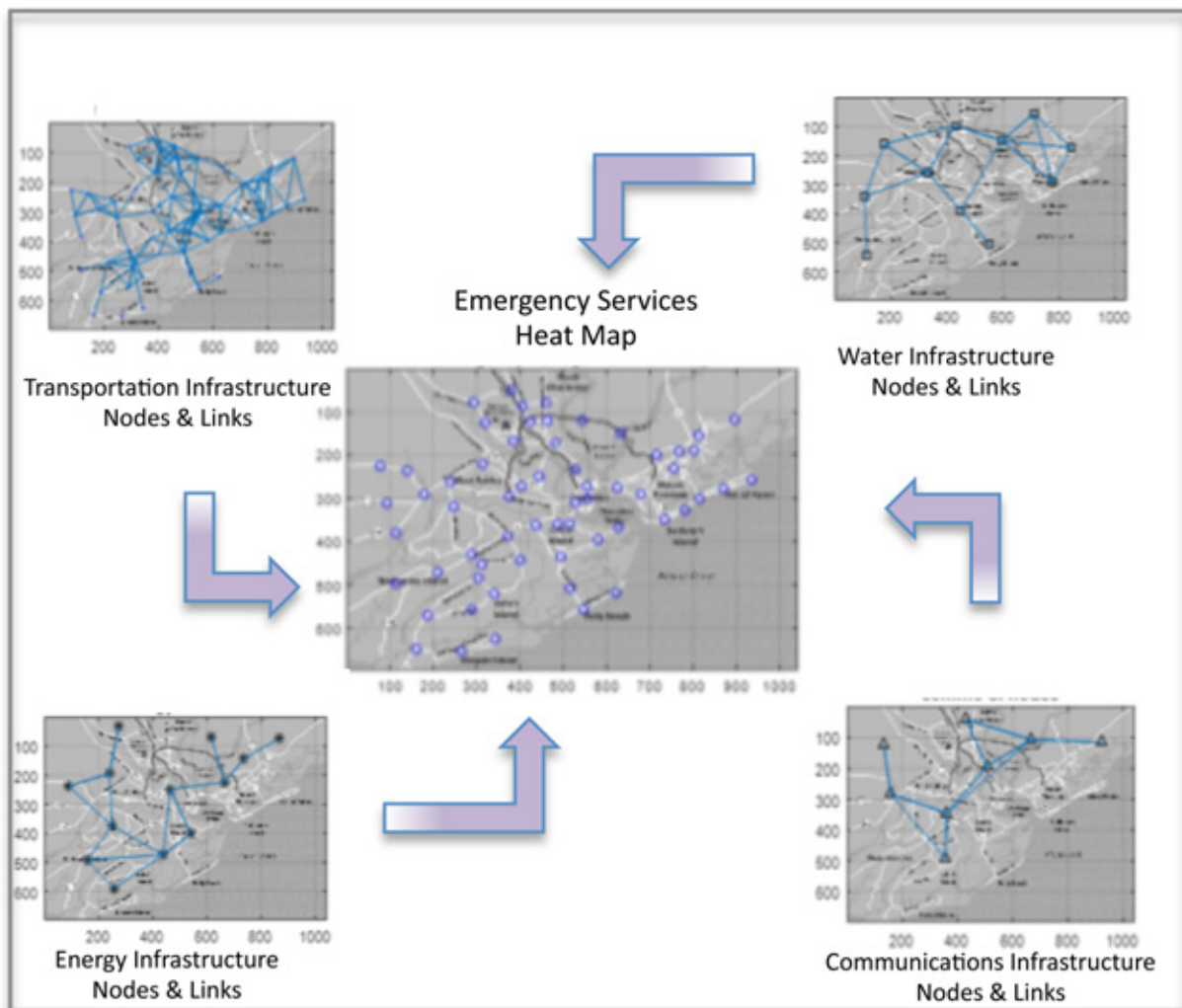


Figure 2. Critical Infrastructure Analysis Model.

- Thinking about the scenario, who is affected? What processes, technology, and training areas are associated with the mission?
- What CI services are needed to perform the operations? Must they be available at 100 percent (e.g., without a specific bridge, response time increases by five minutes)?
- Can the output and input of the CI services be quantified (e.g., one cell tower that also supports a repeater service's one-quarter of the county)?
- What can make the nodes fail? The links (e.g., generators powering the dispatch center have a two-day supply of fuel)?

With the answers to these types of questions, a preliminary concept of a model emerges, as shown in Figure 1. This is an example of a model that shows the intra- and inter-sector interactions. By engaging with the stakeholders, the layers can be defined and the interdependencies can be analyzed, identifying where current connections exist and opportunities for future connections to be made in order to accomplish missions. Often, discussion by the stakeholders is useful in revealing obvious choke points and resource shortfalls without much rigorous analysis. Ideally, follow-on analysis will surface less obvious connections and potential problem areas.

Develop the Analysis Model of the Problem

Once the data has been obtained and preliminary concepts validated by the stakeholders, the final step is to develop an analysis model of the problem. The model may be developed using several tool types found in the systems engineering or operations research community such as a network diagram, an agent-based model, a systems dynamics model, or a discrete event simulation (see Figure 2).

With the analysis model in hand, stakeholders may begin to insert disturbances and observe the perturbations that ripple through the model. The point of such a simulation is to introduce a disturbance into the system and explore the interdependencies within and between CI sectors. The model concept, as shown in Figure 2, could be used to analyze the interdependencies and understand how the emergency management missions are affected in the event of a disturbance that may initially affect any CI sector or sub-sector. Conducting

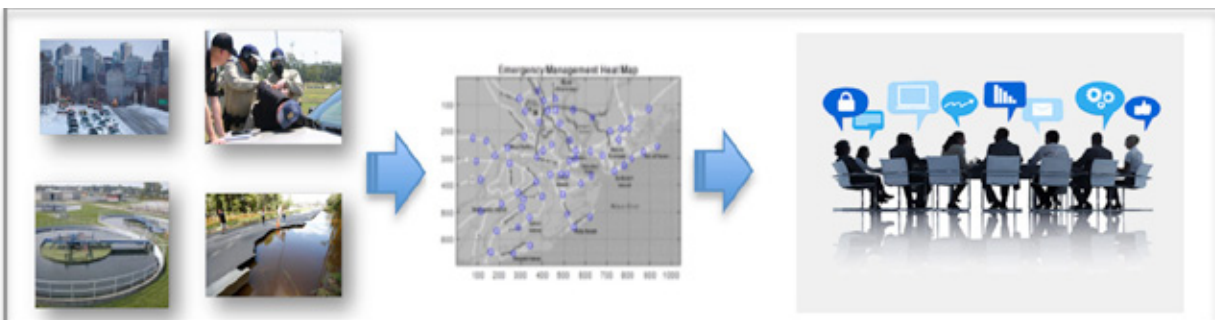


Figure 3. Analysis Outcome Process.

a workshop, or discussion-based exercise, provides an opportunity to discuss the scenario and analysis (see Figure 3).

Based on the analysis, previously unknown relationships between CI sectors or shared resources may be identified. Other potential insights could include CI sectors that are vulnerable to disturbances, requiring strengthening of selected locations or assets (e.g., specific cellular towers or vulnerable substations that service multiple missions and a majority of the population). Lastly, the analysis may bring insights about other stakeholders, requiring additional cooperation and co-usage of the CI sectors. The insights to be gained are only limited by the imagination of the analyst and stakeholders.

“The information required to execute the analysis must be obtained from the stakeholders; walking through illustrative scenarios is frequently useful in gathering this type of information.”

Conclusion

By following a repeatable methodology, the emergency services missions, interactions, and interdependencies can be defined and analyzed in a way that allows decision makers to assess their current state of infrastructure and provide a framework for future relationships and courses of action to produce a more resilient community. This example shows an end-to-end process that bounds the problem, models the mission space, and analyzes the interdependencies and gaps of the existing configuration. Using this type of analysis, decision makers can gain insights into where the critical gaps are within their systems and identify areas for future investment to ensure their missions are satisfied in the wake of a disturbance.

Dr. David Flanigan (pictured above) supports multiple government sponsors in the early stage systems engineering phases of development, working with government, industry, and academic organizations to plan and execute analytical studies in support of advanced concepts and integrated acquisition strategies. He holds the following degrees: B.S. in Physics from the University of Arizona; M.S. in Information Systems and Technology from the Johns Hopkins University; M.S. in Systems Engineering from the Johns Hopkins University, and a Ph.D. in Systems Engineering and Operations Research from George Mason University.

Steven Taylor has experience with state and local government homeland security and emergency management including terrorism prevention and protection. He has Incident Command Systems (ICS) training and operations experience with a focus on all-hazards emergency management mitigation, planning, and preparedness. His interests include dependency and interdependency identification and understanding. He holds the following degrees: B.S. In History and Environmental Biology from Heidelberg University; M.P.A. In Environmental Policy and Natural Resource Management from Indiana University.

Significant contribution to the article was provided by:

John Contestabile, who is the program manager for Homeland Security for the Johns Hopkins University Applied Physics Laboratory and a member of the Preparedness Leadership Council International. He previously held positions at the State of Maryland Department of Transportation (MDOT) and also was the director of the Maryland State Communications Interoperability Program (MSCIP). He holds the following degrees: B.S in Engineering from Worcester Polytechnic Institute; M.B.A from University of Baltimore, Maryland.

identiFINDER® R200

PAGER-SIZED, IDENTIFICATION-CAPABLE



NEW PRODUCT!

Meeting the mission: preventative radiological detection

FLIR identiFINDER® R200: Rugged and belt-wearable, this tool delivers immediate threat alarms and radioisotope identification to front-line responders during a radiological event.

www.flir.com/domprep



The World's **Sixth Sense**®

Bending the Cost Curve Through Better Design

By David J. Kaufman

The financial costs of natural disasters have been steadily climbing in recent decades. For policy makers to reverse this trend, they must understand the nature of the risks they face, the short-term and localized lenses through which financial decisions are viewed, the pricing signals for risk, and the standardized building measures needed to strengthen development practices.



In the [10-year period](#) from 2004 through 2014, natural disasters caused \$1.4 trillion in damage globally, affecting 1.7 billion people and taking the lives of 700,000. The United States experienced more disasters over this period than any other country except China, at a cost of \$443 billion in damages – winning the dubious prize for the most disaster damages, and representing close to a third of total global losses. When placed in historical context, this 10-year period accentuates a dramatic increase in the costs of natural disasters over the past 50 years. To understand what is driving this trend, and what can be done about it, key factors contributing to the rising costs of disasters must be examined.

Key Factors in Rising Disaster Costs

Three key factors underlie the rise in disaster costs: (a) The variability and intensity of hazards are increasing; (b) exposure to natural hazards is increasing; and (c) vulnerability – both social and structural – is increasing.

Variability and intensity of hazards. Changes in the climate are shifting hazard patterns and are expected to further increase the severity, frequency, or scale of extreme weather events in coming years. Drought in the western United States over the past decade has resulted in the driest conditions in 800 years; heat waves have become more frequent and intense, with 2011 and 2012 experiencing almost triple the long-term average; intense deluges will continue to hit the Northeast in greater numbers; and more rapid swings are occurring between weather extremes.

The Mississippi River in 2011 and 2012 offers a good example: in 2011, the river experienced its worst flooding in decades, and the U.S. Army Corps of Engineers resorted to blowing up levees in order to protect towns and cities from rising floodwaters. A year later, the river was running at historic lows, and dredging was necessary to facilitate the continued flow of barge traffic.

Emergency managers typically assess hazard risk based on the historical record, but prior experience is no longer a sufficient predictor of future conditions. Climate change is

challenging the “rear-view mirror” approach to risk assessments, forcing emergency managers to find new ways to accommodate greater uncertainty in decision-making processes.

Exposure to natural hazards. In 2008, for the first time in human history, more people lived in urban areas than in rural areas, and the pace of urbanization continues to increase. Globally, urban populations are [expected to double by 2050](#), to 6.2 billion. More than [80 percent](#) of the U.S. population lives in urban areas, and as Superstorm Sandy clearly demonstrated, large-scale disasters in densely populated coastal cities present a new class of complex challenges. Coastal counties comprise only 17 percent of the nation’s land area, but contain [52 percent](#) of the U.S. population, and they continue to grow.

Furthermore, there have been massive increases in development in hurricane-prone regions of the country. The insured value of property along the Atlantic and Gulf coasts rose by nearly 50 percent from 2004 to 2012, from [\\$7.2 trillion to \\$10.6 trillion](#). Finally, the globalization of supply chains has raised the likelihood of second- or third-order disaster impacts that are hard or impossible to predict. For example, [Japan’s 3/11 triple disaster](#) not only devastated that country, but it disrupted truck production in Louisiana, affected energy policy in Germany, and sparked a sell-out of potassium iodide on the West Coast of the United States.

Vulnerability – both social and structural. The U.S. population is growing, aging, and diversifying. It is [projected to grow](#) by more than 60 million over the next 25 years, and the percentage of the population over the age of 65 in the United States is expected to increase from 15 percent in 2014 to 22 percent in 2040, shifting the types of services required in the wake of disasters. The population is also diversifying. By 2044, the United States will be a majority-minority nation, continuing to introduce greater complexities in terms of language and cultural diversity into disaster response.

In recent years, high unemployment/underemployment and severe income disparity have been among the World Economic Forum’s top-identified global risks. In the United States: poverty rates have been growing; savings rates have been declining; and disasters have not been democratic. These factors disproportionately affect the poor. Indeed, [Munich Re](#), one of the world’s leading reinsurers, has estimated that half of total economic losses from a disaster come from uninsured losses.

Furthermore, greater numbers of people are living in urban areas with dense concentrations of infrastructure that is often operating beyond its original design criteria, and in areas facing increasing hazard risks. With respect to [structural vulnerability](#):

- Americans take more than 200-million daily trips across structurally deficient bridges;
- An estimated \$21 billion is required to retrofit existing dams; and
- U.S. levees barely passed the American Society of Civil Engineers’ test, receiving a D-.

So, it is not surprising that the costs of disasters are increasing. Complicating these trends is the fact that the replacement cost of most infrastructure has increased faster than the rate of inflation. For example, New York City [estimated the costs](#) to the city from Superstorm Sandy at \$19 billion, and projected the costs associated with the same storm in 10 years to be \$35 billion, a near twofold increase; in 40 years, the estimate was \$90 billion. Together, all of these factors combine to reveal the prospect of a “new normal,” whereby more-frequent and more-costly disasters will progressively continue – and in a time of increasing fiscal constraints at every level of government.

Calibrating Risk & Reward

To succeed in this environment, both public safety professionals and policy makers must strengthen their capability to adapt. How government, nongovernmental organizations, businesses, and individuals work together toward shared outcomes must be more deeply institutionalized. In addition, government actors must begin to think differently about how they engage with and support the private sector to restore critical services after a disaster.

“Climate change is challenging the ‘rear-view mirror’ approach to risk assessments, forcing emergency managers to find new ways to accommodate greater uncertainty in decision-making processes.”

Finally, it is necessary to actively account for and enable the immediate, independent mass-response actions of citizens during crises. However, no matter how effective the preparedness and response efforts, it will never be possible to truly temper the rise in disaster costs (let alone reverse it) unless there is a more accurate calibration of risk and reward in decisions concerning where and how to build.

Better Pricing Signals for Risk

On 13 April 2016, Administrator W. Craig Fugate of the Federal Emergency Management Agency spoke at the National Emergency Managers Association’s Mid-Year Forum in Alexandria, Virginia. Fugate called for a frank discussion about the nation’s development decisions, including what is built, where it is built, and who ultimately bears the risk.

Too often, communities make decisions about new developments – and the standards to which they will be built – through lenses colored by short-term interests (e.g., the immediate economic benefits to the community, potential for job creation, prospects for attracting new tourism), without adequate consideration of risk accumulated over the full lifespan of the new development. This has led to developments that may be insurable today but may not be insurable in the future – and, in the case of public infrastructure, may lead to an increasing reliance on self-insurance by governments at every level. As Fugate stated, this has the effect

of transferring the risk to the public, but the public does not see that transfer. Long-term risk is invisible because it is not captured on balance sheets. It remains invisible until it reappears in lost productivity, uninsured loss, and the cost to the public to rebuild infrastructure following a disaster.

In addition, the financial risks associated with new developments – whether from the standpoint of lenders, developers, or insurers – are all short-term in nature. There are no effective metrics to price the aggregate risk of new facilities over time into upfront development decisions. This creates skewed financial incentives that encourage further building in hazard-prone areas, as well as a vicious cycle of ever-increasing exposure, hazard risk, and costs to rebuild after a disaster.

Stronger Building Codes

One of the most powerful tools for mitigating disaster risk to date has been the use of model building codes. For more than a century, U.S. communities have used building codes to set a baseline standard for building safety for their citizens. Yet, these codes are typically designed around minimum life-safety standards and are not meant to ensure the continued survivability and functionality of the structure in question after a disaster. Simply put, they are designed to ensure that the occupants can survive the disaster, but the building itself may still need to be razed and rebuilt – driving up recovery costs.

Embracing stronger building codes, including code-plus programs and performance-based approaches to building design, can allow for greater resilience to be built into the design criteria for infrastructure, affording improved survivability not just for occupants, but also for the functions and services supported by the facility in question. An excellent example is the establishment of the Federal Flood Risk Management Standard ([FFRMS](#)), which requires all future federal investments in floodplains (and areas affecting them) to meet a higher level of resilience. Expanding the FFRMS approach to other hazards and emphasizing the broader adoption of code-plus standards in communities allows for the design of greater resilience into the built environment as more-dynamic risks arise in the future.

To truly aspire to becoming more resilient as a society (i.e., with more resilient infrastructure), then the true price tag associated with risk exposure over time must be designed into investment and development decisions. The design criteria for infrastructure, facilities, and homes must address not only today's risks, but also those of tomorrow.

David J. Kaufman is the vice president and director for safety and security at CNA, a nonprofit research and analysis organization located in Arlington, Virginia. He is the former associate administrator for policy, program analysis, and international affairs at the Federal Emergency Management Agency, where he served from 2009 to 2015.

Critical Infrastructure & Strategic Assessment

By David L. Wegner & Sheri Tickner

Globally, government agencies are at a nexus in how to plan for and address society's dependence on infrastructure to sustain economies, support and protect people, and implement strategies to provide for an appropriate level of reinvestment. Partnerships with the private financial world would help develop an effective framework for investments and acceptance of risk.



To begin, even the definition of critical infrastructure depends on one's individual perspective. For many, family and home infrastructure are at the center. Keeping this "family system" safe and functioning is a daily need depending on clean and available water, energy, and shelter. In order to maintain the family system function, there is a need to periodically repair, reinvest, and protect the home "infrastructure."

Sustaining Basic Needs

Critical infrastructure on the town and city level is more expansive and expensive. The water and energy infrastructure needs must be able to deliver basic commodities to homes and businesses in a safe, reliable, and consistent manner. The ongoing domestic water supply incident in Flint, Michigan, which began in 2014, exemplifies the problems that can manifest if the municipal sector does not maintain and sustain its infrastructure. Roads and bridges that connect homes to stores, hospitals, schools, fire and police departments, and jobs are critical elements. Without them, the sustainability and integrity of a town or city would diminish quickly.

On a regional and national level, critical infrastructure gets bigger, more complex, and not any less important. With a growing reliance on the internet and the need to protect against floods and droughts, coastal storms, and other disasters, all of the following would be considered critical to the safety and economy of the nation: electrical grid structures; natural gas pipelines; oil delivery and refineries; regional transportation linkages and connections; airports; harbors and ports; inland waterway systems with locks and dams to regulate flows; hydropower production; and integrity of the data "cloud."

The nation is infrastructure critical at many levels, which vary on a day-to-day basis. Adding to the equation are the unknown effects that future extreme weather events will have on seasonal, sub-seasonal, and daily temperatures and precipitation, as well as the additional compounding stresses that will result. An example is the challenges that many traditional power plants are having with cooling water. As temperatures warm, the intake water for cooling is higher, resulting in less-efficient power production.

Historically, the U.S. federal government has funded construction and long-term maintenance of much of the primary land and water infrastructure. This federal support,

includes the construction of the interstate system, the electrical grid, the inland waterways system, dams; maintenance of harbors and ports; development and safety of airports and railroads; funding for the building of water treatment and distribution facilities; and flood control along rivers. Strategic investments have allowed the nation and economy to grow.

The Crossroad of Need Versus Desire

Today, the nation is faced with a staggering amount of investment dollars required to replace and upgrade infrastructure while facing a future of increased public demand and a dwindling supply of federal dollars. The federal agencies that have traditionally supported energy and water infrastructure development – the Department of Energy, Bureau of Reclamation, U.S. Army Corps of Engineers (USACE), and Environmental Protection Agency – are finding more of their budgets allocated to operations and maintenance rather than construction. So, clearly, reinvestment requires a new approach.

The first step is determining what is “needed” in respect to critical infrastructure versus what is “desired.” Infrastructure priorities must be identified before being able to move forward with replacements, upgrades, or in some cases divestments. One approach is to perform risk-based assessments of existing infrastructure to determine what is critical to existing and planned needs. An assessment must include an expansive dialogue with stakeholders and incumbent federal and state agencies to determine how to define critical

infrastructure and the reasons why. Often, this is the most difficult step as it challenges established or historic perspectives that are hard to let go.

“Today, the nation is faced with a staggering amount of investment required to replace and upgrade infrastructure while facing a future of increased public demand and a dwindling supply of federal dollars.”

A transparent metric-based risk assessment can support logic-based infrastructure investment decisions – for example, the assessment report and process

that Congress directed the USACE to accomplish following Hurricane Sandy. Specifically, the USACE developed infrastructure system rebuilding principles that embrace risk reduction assessments. Many of the lessons learned from Hurricane Sandy were then captured in the USACE’s January 2015 report, entitled [“North Atlantic Coast Comprehensive Study: Resilient Adaptation to Increasing Risk,”](#) a report required by Congress in the Disaster Relief Appropriations Act.

Next is to determine if the infrastructure needs can be addressed through alternative approaches to regional or local management actions. As an example, to improve water supply availability or flood control flexibility, perhaps what is needed is a policy change to the operational rulebooks that govern how specific dams are operated. Alternatively, perhaps allowing water to be temporarily stored in aquifer recharge basins may preclude having to build new dams or costly development of new levees or flood control structures. From a power perspective, decentralizing the electrical grid may meet the same need as hardening

the protection around a power plant challenged by rising sea levels. The point is that all options should be considered, not just the physical replacement.

Lastly, and perhaps the most difficult, is how to pay and contract for updating or replacing infrastructure. Initial development came when the public and politicians in the United States were willing to invest both political and financial capital into rebuilding the infrastructure. Today, the cost of replacement is beyond what Congress is willing to support and, as a result, the reinvestment approach is more focused on “fix when fails” and dependent on supplemental appropriations, which is not a sustainable or predictable equation. This is where innovative financing is needed through public-private-partnerships, Water and Transportation Investment Funds, municipal and state bonding, insurance, mutual funds, and strategic federal and state investments.

Finding Success

The key to success will be to build partnerships with the private financial world to develop the framework that provides a clear path to return on investments and acceptance of risk. To implement any approach that partners with the private sector requires an update to how the government does business, specifically procurement and contracting. Including new approaches that recognize and embrace partnerships are needed to effectively pivot to the changing needs of the nation.

Determining the path forward on addressing reinvestment in critical infrastructure is not easy. Extreme weather events and the impacts of an uncertain environment all require flexibility and resilience in planning and thinking. Development of a strategic infrastructure path forward requires a partnership between the federal, private, stakeholder, and academic worlds.

David L. Wegner (pictured) is a senior scientific consultant with Jacobs. He recently retired from a senior staff position on water, energy and transportation committees in the U.S. House of Representatives. In that position he worked on legislation that directly affected administration policy and federal agency actions related to the U.S. Army Corps of Engineers, the Department of the Interior, the Environmental Protection Agency and the Department of Energy. Prior to serving in Washington, D.C. he worked for over 20 years for the Department of the Interior managing water and science programs in the Colorado River basin and the Grand Canyon. Currently he works as a part-time senior scientist to ICF and continues to provide input and strategic counsel to the National Academy of Sciences, several Members of Congress and international organizations focused on water and climate issues. He currently splits his time between Tucson, AZ, Durango, CO, and the Colorado River. He can be reached at Dave.wegner@jacobs.com

Sheri Tickner is director of asset management strategies, buildings and infrastructure with Jacobs. She is a leader in capital improvement planning for large government clients. With over 20 years of experience, she understands all aspects of asset management: facility condition assessments; land use and infrastructure planning; architectural design; and federal budgeting. Ms. Tickner is an experienced strategist who excels at facilitating “C-suite” work sessions and cultivating strong relationships. Her experience includes long-range master planning, process and procedure policy development, capital program development, schedule implementation and phasing, requirements validation, cost estimating and budgeting, MILCON planning, space planning, construction management, fit out, and occupancy. She can be reached at Dheri.tickner@jacobs.com

June 28 - 30, 2016

Homeland Security Professionals will gather in Tampa for the 2016 National Homeland Security Conference. Guest Speakers Include: San Bernardino PD Chief Burguan, FEMA Reps: Tim Manning, Caitlin Durkovich, Brian Kamoie, Lt. Sam McGhee - Aurora CO Lessons Learned Several NDPC Courses available on site!



**REGISTER
TODAY**

#NHSC2016

www.nationaluasi.com

Water Sector Resilience & Redundancy

By Steven E. Bieber & Pamela P. Kenel

With a rich history of coordinated water supply planning, the National Capital Region has been conducting regional workshops and creating new study results to enhance its ability to address the region's water needs during a crisis. The resulting information will spur further discussion and assessment of drinking water system alternatives for the region.



President Barack Obama issued [Presidential Policy Directive-21: Critical Infrastructure Security and Resilience](#) in February 2013, thus establishing the “policy of the United States to strengthen the security and resilience of its critical infrastructure against both physical and cyber threats.” In particular, the [National Infrastructure Advisory Council](#) has identified the water, energy, transportation, and communications sectors as “lifeline sectors” that should be top priorities for strengthening resilience. Of those sectors, various studies such as the [Regional Catastrophic Preparedness Grant Program Supply Chain Resilience Project](#) have found that a failure of the water sector (drinking water or wastewater) could prove to have particularly catastrophic consequences.

Brief History of D.C.'s Water Infrastructure

In the Metropolitan Washington Region, water-sector issues have been addressed for decades. The Metropolitan Washington Council of Governments ([MWCOCG](#)) – comprised of 300 elected officials from 22 local governments, the Maryland and Virginia state legislatures, and U.S. Congress – has worked since its founding in 1957 to address the management and protection of the drinking water supply for the region, including the resources of the Potomac River. The Chesapeake Bay and Water Resources Policy Committee addresses regional water quality issues for MWCOCG. The Interstate Commission on the Potomac River Basin ([ICPRB](#)), authorized by an Act of Congress in 1940, is an advisory, interstate compact agency of the Potomac basin states of Maryland, Pennsylvania, Virginia, West Virginia, and the District of Columbia that, among other items, addresses water supply issues in the Metropolitan Washington Region.

In July 1982, the Baltimore District of the U.S. Army Corps of Engineers, Fairfax Water, the [Washington Suburban Sanitary Commission](#), the District of Columbia, and the ICPRB signed a Water Supply Coordination Agreement to direct their operations during drought. ICPRB's Section for Cooperative Water Supply Operations on the Potomac was designated by the Water Supply Coordination Agreement to be responsible for coordination of water resources during times of low flow to keep the off-Potomac reservoir resources balanced while meeting environmental requirements and municipal demands for water. The off-Potomac resources include Jennings Randolph, Savage, Little Seneca, Occoquan, and Patuxent reservoirs. Included as part of the Water Supply Coordination Agreement are reliability assessments to be completed every five years. ICPRB completed the most recent assessment in 2015.

In 1999, MWCOG's Board of Directors established a Task Force on Regional Water Supply Issues to: review regional water systems; examine the roles of the water utilities, government, and others; and identify key issues in long-term water supply planning and drought management. The Task Force work led to significant revisions to the regional Water Supply Emergency Plan and the adoption of a regional Drought Emergency Plan. For decades, regional agreements such as the Water Supply Coordination Agreement, the Low Flow Allocation Agreement of 1978 (and subsequent modifications), and the regional Drought Emergency Plan have been used to successfully manage the Metropolitan Washington Region's water supply as a system.

New Study & Series of Workshops

Consistent with the region's longstanding record of effective and coordinated regional water supply planning – which promotes the sharing of benefits, risks, and resource costs – a regional water system redundancy study is presently underway, building on a previous 2007 study. The main purpose of this regional study is to investigate options for improving water supply resilience and security through assessment of adding supplemental water storage capacity, system interconnections, and other actions. Funding to carry out the study was made available from a Federal Emergency Management Agency Urban Area Security Initiative grant. Major study participants include MWCOG, ICPRB,

Washington Suburban Sanitary Commission, Fairfax Water, the Washington Aqueduct, DC Water, several other local governments/utilities, and Black & Veatch, a consultant engaged to perform the study.

“Consistent with the region's longstanding record of effective and coordinated regional water supply planning – which promotes the sharing of benefits, risks, and resource costs – a regional water system redundancy study is presently underway.”

Working with MWCOG staff and other project partners, Black & Veatch scheduled five workshops, between June 2015 and March

2016, with key regional water supply utilities in the National Capital Region. The workshops were essential to conducting the analysis by satisfying the general goals of the project and ensuring a working dialogue among utilities, MWCOG, and Black & Veatch. The operation of existing interconnections and water-sharing arrangements between utilities was discussed, as well as opportunities to improve the region's capability to move water across individual geographic system boundaries – as would be required in a regional emergency situation. Each workshop focused on reaching group agreement on important steps in the analysis. The goals of the workshops were to:

- Establish the minimum level of regional water supply service acceptable during an emergency, based on expected customer demand during planning year 2040;
- Define failure events that could result in water supply outages by exceeding the region's system storage capability;

- Quantify the probability of occurrence of failure events, duration of outages, and number of customers affected; and
- Identify and define (for each failure type) potential infrastructure improvements to mitigate water supply outages.

A fifth workshop was held in March 2016 to review outputs from a risk model that synthesized the failure conditions, outage assumptions, and potential combinations of infrastructure improvements. A business case analysis of the combinations of improvements provided insight to the benefits and costs of improvements, and accounted for water system synergies and dependencies. The methodology allowed the infrastructure improvements to be evaluated with respect to regional system benefits, and provided a cost-efficiency ranking relative to projects and costs of mitigating the group of identified risks.

The ongoing National Capital Region water system resilience and redundancy study is scheduled for completion by 31 May 2016. During April and May 2016, regional water utilities and other stakeholders will continue to assess potential combinations of infrastructure improvements. Some of the information that will be developed before the end of May includes:

- Identification of daily operational benefits associated with specific projects that were not considered in the initial benefit-cost ratios;
- A sensitivity analysis to assess how factors like the frequency of outages might change the priority rankings; and
- A breakdown of estimated costs and benefits by jurisdiction.

When completed, the resulting information will provide the National Capital Region with a foundation for ongoing regional discussions of priorities, timing, and funding of infrastructure to enhance the region's ability to adapt and respond to customer water needs during regional emergencies.

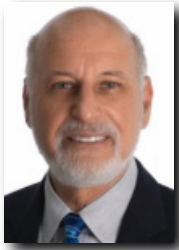
Steven E. Bieber is the chief of the Urban Watershed Programs and Homeland Security, Metropolitan Washington Council of Governments and has over 25 years of experience in water quality management, environmental regulation, critical infrastructure protection, and public policy. Presently, he is responsible for managing Council of Government's regional Anacostia Restoration Partnership, water security programs, energy security programs, critical infrastructure protection, drought management and response, urban stream restoration, green infrastructure, and other related environmental programs for local governments and utilities in the Washington, D.C., area. Previously he was chief of watershed planning and outreach for the Maryland Department of the Environment. He also has extensive experience working with international groups on watershed management and water security issues. He holds a B.S. degree in zoology from Michigan State University, an M.S. degree in oceanography from Old Dominion University, and a Master of Public Administration degree from the University of Baltimore.

Pamela Kenel is a solution lead in the Smart Integrated Infrastructure business for Black & Veatch, 18310 Montgomery Village Ave., Suite 500, Gaithersburg, MD 20879; KenelPP@bv.com. She specializes in water resources, planning, and sustainability solutions, applying innovation and data analytics to smart community and water utility issues. She chairs the Sustainability & Climate Change Technical Advisory Workgroup for the American Water Works Association; holds a B.S. degree in civil engineering from Virginia Tech, an M.S. degree in engineering from the University of Maryland; and was a Ph.D.-candidate in civil-environmental engineering at Virginia Tech.

Rising Sea Level – A Stealth Threat

By John Englander

Sea-level rise is in the news with increasing frequency. Yet, the longer-term threat is largely underestimated. The risks in terms of economic impact, emergency preparedness, and national security have profound strategic importance. The latest news from Greenland and Antarctica strongly suggests that there is no time to waste when it comes to preparing for this threat.



Extrême change caused by sea-level rise (SLR) has only begun to shift the shorelines. Following are nine key facts that are often overlooked or misunderstood.

Ability to Stop Sea-Level Rise

Higher sea level is now unstoppable despite efforts like the recent climate negotiations in Paris (known as [COP-21](#)), which are commonly perceived to be a potential solution to sea-level rise (SLR). As explained in the blog post, [Paris Climate Agreement – The Good, the Bad and the Ugly](#), the 196 countries only agreed to limit maximum global warming to 3.6°F (2.0°C) over pre-industrial rates, but could not even agree on a method to reach the goal. That level concedes an additional 2°F beyond the 1.5°F that has already happened. Even if the agreed target can be reached, basic physics and thermodynamics guarantee that vast additional amounts of land ice will melt, raising sea level much higher.

Despite these very worthwhile efforts to reduce greenhouse gas emissions and the various sustainability efforts, so much excess heat has already been stored in the oceans that the world is now committed to substantial SLR with no hope of avoidance. Nations have passed a tipping point. However, it is important to note that, if they do not reduce greenhouse gas emissions and slow the warming process, then ice-sheet melt and SLR would accelerate and be dramatically worse – potentially catastrophic – within this century.

Accuracy of Projections

SLR could be much worse than most projections suggest. Nearly all the forecasts omit or minimize contributions from Antarctica for a reason that is misleading. Scientists are essentially asked to state how much SLR will occur by the year 2100, but must be able to document the number to roughly a two-thirds statistical confidence (one standard deviation). The question of how several miles of ice on Greenland and Antarctica will collapse cannot be answered precisely anymore than when the Yellowstone volcano will blow or the next major San Andreas earthquake will occur.

Uncertainty about the timing of an event does not diminish its danger. In the case of those two ice sheets disintegrating, measurements and other data present a very clear picture of

increasing instability. December 2012 projections of [SLR](#) this century range from 3 to 6 feet, but always contain a statement that higher values cannot be ruled out. Furthermore, every few years, the upper end of the projection is generally raised. Scenario planning for SLR often uses an average of the various projections presented. The naiveté of such an approach becomes clear when compared to planning for familiar disasters like hurricanes or earthquakes, where scenarios are planned around extreme cases. The underestimate is even worse since the assumed “worst case” is not at all the worst case.



Perception of Flooding vs. Sea-Level Rise

Flooding from storms, heavy rainfall, and extreme tides is often confused with SLR. Although it is true that rising sea level would raise or amplify each of those short-term duration events, there are fundamental differences. Higher sea level is global and is essentially permanent, as it is almost certain to persist for more than a thousand years.

Presentation of Metrics & Variations

Global average sea level – the often-cited metric – misses a vast range of regional variations due to ground subsidence and changing ocean currents. As a global average, over the past century, sea level is approximately [8 inches higher](#). In New Orleans, Louisiana, however, the rise has been over 45 inches, and, in Norfolk, Virginia, 30 inches, with the difference mostly being land subsidence. Rising sea level presents different problems in different places. For example, what works in Manhattan, New York, would not work in Miami, Florida, due to the porous limestone that makes sea walls ineffective.

Threats to Non-Coastal Areas

Unlike the damage from storm waves that are somewhat limited to the coastline, SLR extends through marshes and wetlands and can push hundreds of miles up tidal rivers, greatly expanding the vulnerability zone. For example, Sacramento, California, is on a tidal river and is extremely vulnerable to SLR though it is over 80 miles from the coast.

Consideration of Direct & Indirect Vulnerabilities

Wider community and peripheral vulnerability needs to be considered as well. For example, perhaps a building has adequate elevation and design to maintain functional use when sea level is three feet higher. However, the access roads, utilities, or distant zone of

vulnerability could affect the building indirectly or even create a virtual “island” due to submerged areas in the surrounding region. Rising sea level needs to be considered at the level of a particular asset, the various infrastructure layers, and the regional or even international level.

Effects on Critical Infrastructure

Problems are not just limited to flooding. For example, sustained higher sea level would change the critical clearance heights for vessels getting under bridges, where tolerances are now sometimes measured in inches. It would also mean groundwater penetration into landfills, fresh water aquifers, toxic waste sites, and cemeteries, posing new situations for public health and safety.

Development of Realistic Projections

Most design specifications do not take into account a realistic range of SLR over the planned or true lifetime of a project. This includes a vast range of work: road elevations, drainage contours, bridge heights, tunnel entrances, water and wastewater infrastructure,

“As a global average, over the past century, sea level is approximately 8 inches higher. In New Orleans, Louisiana, however, the rise has been over 45 inches, and, in Norfolk, Virginia, 30 inches, with the difference mostly being land subsidence.”

nuclear power plants, refineries, ports, etc. Design life for projects is often 20-30 years. Adding the lead-time for project approval and construction can add another decade – thus getting into the mid-century.

Although design life and financing may only look to mid-century, the reality is that major

buildings and infrastructure often are in use more than a century after construction. The latest sea-level projections from the U.S. National Climate Assessment exceed six feet by the end of this century. This presents a challenge because communities cannot wait until the collapse rate of Antarctica becomes unambiguous before raising or relocating all coastal assets and infrastructure.

Hope of Technology

“Future technology” is often cited as the solution to the problem of SLR, yet sober evaluation shows that to be little more than wishful thinking. Although innovation and new technologies could certainly play a part in SLR adaptation measures, engineers must understand the limitations when protecting vast assets and landmasses – urban as well as rural. Technology in terms of electronics like smartphones is its own category and does not directly relate to stopping SLR. Technological advances will likely lead to the creation of power from non-greenhouse gas energy sources and continued advances in materials and design. However, there is no way to stop ice from melting at 32°F or to stop sea level from rising as

the size of the ice masses on land decrease. The ocean cannot be “pushed” downward. It does not care about laws, regulations, or politics. The ocean will do what it will, like other forces of nature such as hurricanes, tornadoes, earthquakes, and avalanches.

Actionable Items

The disaster preparedness community must now perform at least three actions:

- Get informed and know the facts. Understand how SLR might affect specific areas of expertise. Expose the new reality to colleagues and professional organizations to expand scenario planning and discussion.
- Assist audiences in assessing the vulnerabilities of future projects. For example, a “9-box matrix” can plot short-, medium-, and long-term time horizons against the realistic low, medium, and high scenarios for flooding from rising sea level, combined with the impacts from storms and extreme tides. Different locations and clients have different time horizons and risk tolerances. This tool allows for a full range of scenario planning and vulnerability assessment.
- Seize the opportunity to be seen as a leader. SLR is a long-term trend that will cause tremendous disruption, but also tremendous economic growth and opportunities. As businesses and communities continue to realize the necessity of SLR adaptation, enormous projects can be undertaken to build resilient communities. Now is the time to be on the forefront of SLR adaptation planning, building, and design.

Communities are in the early stages of recognizing the revolutionary reality of sustained and accelerating sea-level rise. It is becoming clear that each community needs to help the international community prepare for this unprecedented era – thus rising with the tide.

John Englander is an oceanographer, consultant, and leading expert on sea level rise. His broad marine science background with degrees in geology and economics, and personal experience in Greenland and Antarctica allow him to see the big picture on sea level rise. He brings the diverse points of view of an industry scientist, entrepreneur, and chief executive officer (CEO). For over 30 years, he has been a leader in both the private sector and the nonprofit arena. The legendary Captain Jacques Cousteau tapped Englander to succeed him as CEO. Today, as the founder of the [Rising Seas Group](#), Englander works with businesses and government agencies to understand the risks of sea level rise and the need for “intelligent adaptation.” He goes beyond the usual projections and explains the “uncertainties” that could yield considerably higher sea level as early as mid-century. His bestselling book, “High Tide on Main Street: Rising Sea Level and the Coming Coastal Crisis,” clearly explains the science of sea level rise, the impending devastating economic impacts and the opportunity to design for a more resilient future. He is a sought after speaker. In recent weeks he has given keynote lectures at the U.S. Naval Academy and the American Planning Association. His blog and website are at: www.johnenglander.net

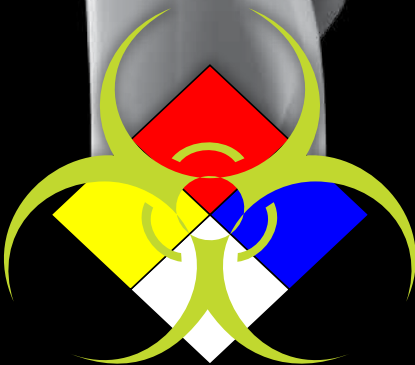
Invisible Threats Exposed



AP4C

**Portable Chemical Detection System
Protects First Responders, Military & Infrastructure**

- Fast, Reliable Analysis of Invisible Hazards Saves Time & Lives
- Unlimited Simultaneous Detection Exposes Unknown Agents
- Low Maintenance & Operation Costs Save Money
- Rugged Handheld Design is Easy-To-Use With Minimal Training
- Complete System Includes Accessories & Case for Easy Transport



[Learn More Online](#)

PROENGINE

Chemical and Biological Detection Systems

Replacing Aged Infrastructure: The Bundled Bridges Approach

By Thomas Clark

Pennsylvania serves as a case study for a new project that could help fortify the nation's aging infrastructure. A new cost-effective approach for rehabilitating bridges is improving safety, mobility, and resiliency for communities across the state as other states learn key lessons in order to implement similar programs within their jurisdictions.



The Need

States and local governments across the United States are struggling with replacement and rehabilitation of structurally deficient and functionally obsolete bridges. The Federal Highway Administration (FHWA) defines structurally deficient bridges as having significant portions with deteriorated conditions and potentially reduced load-carrying capacity. Such bridges typically require significant maintenance and repair to remain in service and will eventually require major rehabilitation or replacement to address the underlying problems.

A bridge is considered functionally obsolete when it does not meet current design standards (such as lane width), either because the volume of traffic carried by the bridge exceeds the level anticipated when the bridge was constructed and/or the relevant design standards have been revised. Structurally deficient and functionally obsolete structures have significant impacts on mobility and resiliency, as many of these structures have weight limits and cannot be used for larger vehicles.

According to [FHWA statistics](#), of the 609,539 bridges in the United States, nearly 60,000 (9.6 percent) are rated as structurally deficient. Pennsylvania leads the nation with 21.0 percent of its bridges considered structurally deficient, while Nevada has just 1.8 percent of its structures in this rating category. In addition, more than 79,000 structures across the nation have been rated as functionally obsolete, meaning that 22.6 percent of U.S. bridges are either structurally deficient or functionally obsolete.

The Approach

With the Federal Highway Trust Fund and local funding sources not keeping pace with the ever-growing needs of the aging infrastructure, many are seeking innovative approaches to maintain mobility and ensure resiliency. To this end, some states are implementing an innovative design, construction, and financing procurement methodology to more effectively reconstruct infrastructure while reserving sufficient resources for new infrastructure. One approach that accelerates the delivery of bridges is to “bundle,” or combine, a large number of structures into one contract using a design, build, finance, and maintain (DBFM) public-private partnership (P3) delivery model. In this way, a large number of structures can be addressed in a much shorter time period, saving both time and money.



Fig. 1. Pennsylvania Rapid Bridge Replacement Project
(Source: PennDOT).

A unique feature of the DBFM approach is that it considers not just the design and construction of the new structures, but also lifecycle maintenance for a predetermined period. Typically, a 25- to 30-year fixed-price maintenance term is negotiated, with the owner making monthly availability payments (under which the concessionaire receives a periodic “availability” payment from the public partner based

on the availability of a facility at the specified performance level) over the term of the concession. The availability payment is sized to cover debt repayment, maintenance costs, and project company costs indexed to inflation. Payments are subject to deductions for poor performance, thus ensuring quality construction and maintenance. During the maintenance period, all of the maintenance and rehabilitation risks are shifted to the private sector, allowing the owner to allocate valuable resources to other needs within its network.

The Benefits

Utilizing the bundled bridge DBFM model offers the following benefits to owners:

- Economies of scale, due to the bundling, lead to design and construction efficiencies and cost savings.
- An accelerated schedule results from the standardization of bridge designs and construction methodology.
- Completing a large number of bridges (500+/- has proven to be a cost-effective range) in approximately three years minimizes the inflation effect that would result from a normally much longer replacement schedule.
- Active preventive maintenance lowers the life-cycle costs of bridges.
- Rehabilitated bridges improve safety, mobility, and resiliency, and the number of posted bridges is reduced.
- A fully functioning roadway system provides for cost-effective movement of goods and services, resulting in enhanced economic vitality.

The Case Study

To date, Missouri and Pennsylvania have utilized this bundled bridge approach to address their structurally deficient inventory problems. The Missouri Department of Transportation used a design-build procurement method to replace 554 rural structurally deficient bridges across the state, while the Pennsylvania Department of Transportation (PennDOT) recently chose to award a DBFM contract to a private-sector consortium (see Figure 1). The following briefly describes Pennsylvania’s approach.

In 2012, the Pennsylvania legislature passed [Act 88](#), enabling legislation that allows public infrastructure works to be procured using a P3 methodology. For roads, bridges, and tunnels, Act 88 provides for either tolled or untolled infrastructure, with the initial financing coming from private funds. This initial funding can then be repaid to the private entity under a variety of methods, including tolling or availability payments, which are essentially annual fees paid to the private entity by the owner, tied to certain performance standards.

For its bundled bridges program, PennDOT decided to use a DBFM approach with availability payments. The contract was awarded in late 2014 and covers 558 mostly small, rural, structurally deficient structures located within all 11 of Pennsylvania's transportation districts. In order to accelerate the program, PennDOT developed the following criteria to determine which bridges would fit its timing goals:

- Limited or no right-of-way acquisition – the structure could be replaced in largely the same location;
- No tolled or historic bridges – no lost revenue or preservation issues;
- No roadway bridges crossing railroads – saves permitting time; and
- Mostly simple one- or two-span bridges – less time required to design and construct.

The design-build portion of the contract totaled \$899 million, approximately \$1.6 million per bridge. The bridges are being designed and constructed in the first three years of the contract and will then be maintained by the private sector concessionaire for 25 years. At the end of the 25-year maintenance period, the bridges will be handed back to the Commonwealth of Pennsylvania. The bridges must be maintained to achieve stipulated performance standards during the maintenance term and at the end of the maintenance period. Failure to meet these performance standards could subject the concessionaire to penalties.

State officials have commented that replacing the bridges using this P3 DBFM procurement methodology saved between 15 and 20 percent compared to a more traditional design-bid-build procurement, which does not include the life-cycle maintenance benefits. More than 30 states have enacted P3-enabling legislation, and all are considering how to best utilize this procurement tool to rehabilitate or replace aged infrastructure. As owners continue to struggle to find sufficient funds to maintain safe and resilient bridges, they are watching the Pennsylvania Rapid Bridge Replacement project, seeking to use lessons learned to implement similar programs.

Based in the firm's Washington office, Thomas Clark currently serves as vice president of [Parsons](#), responsible for the development of the group's East Coast Roads & Structures work in market sectors including design-build, public-private partnerships, tunnel engineering, planning, asset management, and highway/bridge design. He has been working to develop and implement innovative highway design, maintenance, and operations contracting methodologies since 1999, and has provided consulting services to a number of state Departments of Transportation. He holds an undergraduate degree in economics from Harvard University and an MBA in finance and marketing from the Wharton School, University of Pennsylvania.

U.S. Response to Outbreaks of Avian Influenza

By Gary A. Flory

Although avian influenza outbreaks occur periodically in poultry flocks, only recently has avian influenza been considered a significant threat to human health and the global economy. The 1997 emergence of H5N1 first brought attention to avian influenza's ability to cause disease in humans. However, human infection with influenza from avian sources is not a new phenomenon.



Using lung tissue from 1918 influenza victims, researchers have conducted a genetic analysis of the 1918 virus and have linked the virus to avian origins. This [1918 influenza](#), also known as the Spanish flu, infected up to one-third of the worldwide population and resulted in the death of up to 50 million people.

In her 2016 book, "[Pandemic: Tracking Contagions, From Cholera to Ebola and Beyond](#)," science journalist Sonia Shah cites a study in which 90 percent of epidemiologists say they believe a global pandemic will sicken one billion and kill up to 165 million within the next two generations. Though not all scientists agree with the validity of this study, clearly the control of emerging infectious diseases such as avian influenza is a crucial part of any nation's health agenda.

The 2014-2015 outbreak of Highly Pathogenic Avian Influenza (HPAI) in the United States illustrates the economic impact of an avian influenza outbreak. Between 19 December 2014 and 17 June 2015, [219 detections of HPAI](#) were reported across the country, resulting in the death – either directly from the virus or in an effort to prevent the spread of the disease – of nearly 50 million birds. The total cost of the outbreak extends well beyond the cost of destroying and disposing of the birds and includes lost market opportunities from trade restrictions. Eighteen countries banned U.S. poultry products, including Russia, China, South Korea, and Thailand. Thirty-eight countries instituted regional restrictions including Canada, Mexico, Japan, Singapore, and the European Union. Estimates put the total economic impact of the 2015 outbreak at over [US\\$3.3 billion](#).

On 15 January 2016, a highly pathogenic strain of avian influenza ([H7N8](#)) was detected in a commercial turkey operation in Dubois County, Indiana. Subsequent surveillance efforts identified eight cases of low pathogenic avian influenza at nearby turkey operations. Lessons learned from the 2015 outbreak of HPAI in the Midwestern United States guided the response in Indiana and included the importance of having strong carcass and manure management plans.

Role of Carcass Management

An effective disease management strategy includes a number of components including biosecurity, surveillance, quarantine and movement control, mass depopulation, carcass

disposal, and cleaning and disinfection. Outbreaks of foot-and-mouth disease (FMD) in the [United Kingdom](#) in 2001, and Japan and [South Korea](#) in 2010 are clear reminders that carcass disposal plays a critical role in an effective disease response strategy. Dramatic photos of cattle burning in open pyres during the 2001 outbreak in the United Kingdom resulted in widespread public opposition to open burning.

In Japan, the lack of acceptable burial sites resulted in delays in disease eradication efforts and required the Japanese government to implement a vaccinate-to-kill strategy. This strategy, although helpful in limiting the spread of the disease, required the expenditure of already limited resources. In addition to increasing resource demands, delaying eradication efforts may result in increased case detections and total economic impact. A [recent study](#) of a simulated FMD outbreak in California concluded that delaying the response from 7 to 22 days increased the mean number of herds under quarantine from 680 to 6,200. The economic impact of this simulated FMD outbreak in California increased from \$2.3 billion to \$69 billion when the delay increased from 7 to 22 days.

In South Korea, disease eradication efforts resulted in the destruction of 20 percent of the country's livestock and the creation of over 4,000 burial sites. This widespread carcass burial resulted in concerns about massive environmental impacts associated with this activity. Although investigations to characterize the actual effects of this activity are in their early phases, many worry that the environmental impacts, including those to drinking water supplies, will last for decades. One unconfirmed report from rural South Korea described drinking water wells flowing red following the burial of livestock at a nearby burial site.

Despite this history of costly and ineffective carcass disposal efforts, disposal methods have advanced little in the decade since the 2001 FMD outbreak in the United Kingdom. A disease outbreak today should not be managed with the same techniques used in previous decades, which would result in the same economic, health, and environmental impacts. Now, more than ever, first responders need better options for disposing of animal carcasses.

Poultry Carcass Management

As described at the [joint annual meeting](#) of the U.S. Animal Health Association and the American Association of Veterinary Laboratory Diagnosticians, poultry carcasses have been disposed of with a variety of methods including burial, incineration, landfilling, and composting:



Fig. 1. An air curtain destructor being used to destroy turkey carcasses infected with low pathogenic avian influenza in Virginia in 2002 (Source: Gary Flory).

- *Burial* – The burial of poultry carcasses in pits and trenches has been a common practice for decades and is still widely accepted. Millions of birds have been buried in the response to the H5N1 and H7N9 strains of avian influenza circulating around the globe. Though burial can be fast and cheap, concerns about the environmental impact of the practice are increasing.
- *Incineration* – During the avian influenza outbreak in Virginia in 2002, more than 600,000 birds were burned in air curtain destructors (see Figure 1). During the 2015 HPAI outbreak in the Midwest, several types of incineration units were used with varying degrees of success.
- *Landfilling* – Poultry carcasses have been disposed of at landfills since the emergence of the modern poultry production industry (see Figure 2). The two greatest challenges of the method are managing the biosecurity implications of transporting infected carcasses to the landfill sites and gaining approval from the owners of the landfills. In 2015, it took 42 days to gain approval to dispose of infected poultry carcasses at landfill facilities. These delays can have significant logistical implications.



Fig. 2. Disposal of poultry carcasses infected with low pathogenic avian influenza in a Virginia landfill in 2002 (Source: Gary Flory).

- *Composting* – The poultry industry in Delaware was the first to implement a composting strategy during a 2004 outbreak in broiler chickens. Later that same year, Virginia researchers demonstrated the ability to compost market aged turkeys. This technique was used during low pathogenic avian influenza outbreaks in West Virginia and Virginia in 2007 (see Figure 3). Based on the success of these experiences, composting was the primary carcass disposal method used during 2015 and 2016 HPAI outbreaks.

Composting on a large scale, like during an animal disease outbreak, requires technical expertise and familiarity with agricultural operations. Early in the 2015 outbreak, the U.S. Department of Agriculture (USDA) and poultry industry representatives were

concerned about consistency in implementing the composting process. Small variations in design can significantly increase the cost of the composting process or, even worse, decrease the processes' effectiveness in inactivating the influenza virus. To address this concern, USDA established the Composting Technical Committee made up of subject matter experts from around the country with experience composting animal mortality.



Fig. 3. Composting outside the poultry houses during an outbreak of avian influenza in Virginia in 2007 (Source: Gary Flory).

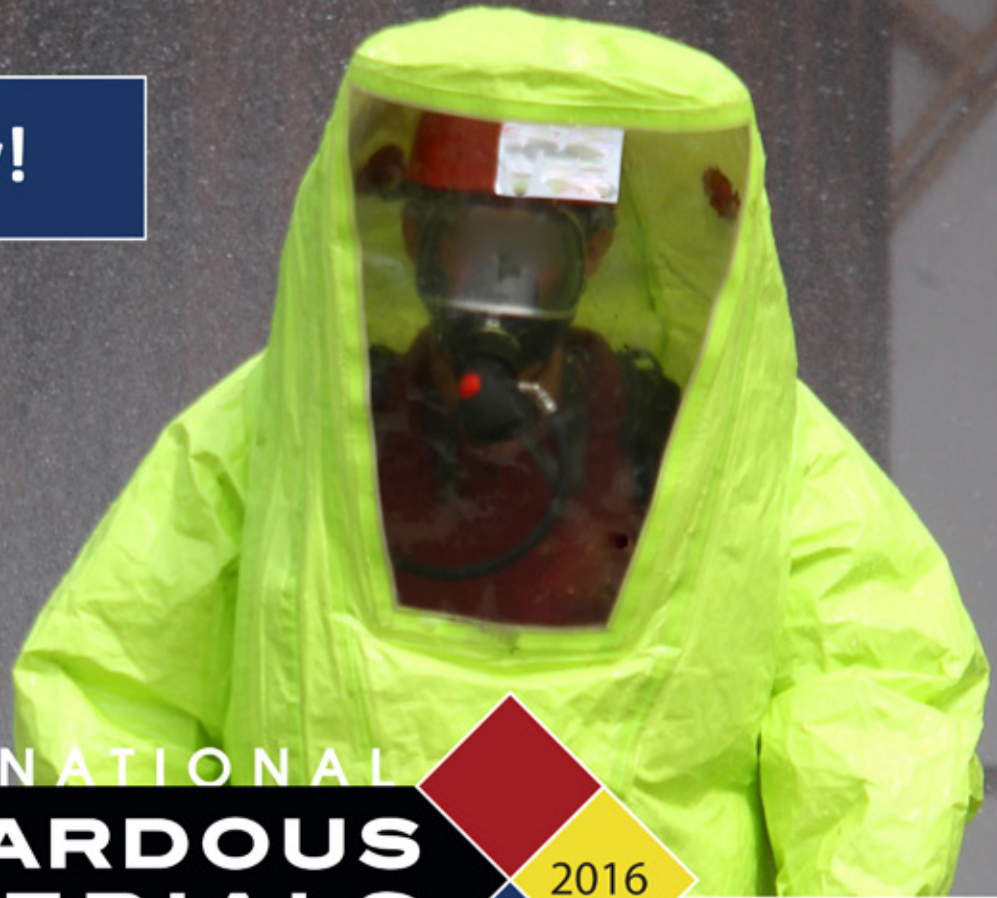
In May 2015, the committee began meeting weekly to discuss technical issues and to develop USDA's composting protocol, entitled [Mortality Composting Protocol for Avian Influenza Infected Flocks](#). In addition to developing the composting protocol, subject matter experts traveled to each infected farm to oversee composting operations. With their guidance, farmers and emergency response contractors were able to successfully compost each farm's poultry carcasses, bedding material, feed, and eggs. The compost created by the process was deemed free of active virus and suitable for application to agricultural lands as a soil amendment.

The Future of Animal Mortality Management

Animal carcass disposal remains a significant weakness in many nations' comprehensive national strategies for biodefense. Although incidents of high-consequence foreign animal diseases like African swine fever, avian influenza, and foot-and-mouth disease are increasing, response plans often lack comprehensive carcass disposal considerations. The next outbreak is likely just around the corner. Now is the time to revisit and update foreign animal disease response plans.

Gary Flory is the agricultural program manager for the Virginia Department of Environmental Quality and an independent global consultant, trainer and speaker in the areas of emerging infectious diseases, counter-agroterrorism, One-Health, and animal carcass disposal. As a disposal subject matter expert for the U.S. Department of Agriculture (USDA), he was deployed on five separate occasions to support USDA's response to the 2015 and 2016 HPAI outbreaks and was a lead author of USDA's recently released Mortality Composting Protocol for Avian Influenza Infected Flocks. He participates in a variety of working groups including: the Chesapeake Bay Program's Agricultural Workgroup; Virginia Poultry Disease Taskforce; Animal Health Quadrilateral Meeting of the Emergency Management Task Group & Disposal, Destruction & Disinfection Network; BioWatch Extended Veterinary Network; Virginia Catastrophic Livestock Mortality Taskforce; and the National Homeland Security Research Center's Technology Testing and Evaluation Program Water Security Stakeholder Committee. He can be contacted at gary@garyflory.com

Register Today!



INTERNATIONAL
**HAZARDOUS
MATERIALS**

2016

Response Teams Conference

Conference Dates: June 16-19

Hilton Baltimore
Baltimore, Maryland

Presented by the IAFC
in partnership with



Premier Media Partner

FireRescue.com

FIRE
CHIEF

Powered by the IAFC



Revisiting PROTECT

By Ian Schaefer

Two decades of federally funded research and development culminate in a real-time chemical, biological, radiological, nuclear, and explosive (CBRNE) system for detection, surveillance, and crisis management for the nation's critical infrastructure. Argonne National Laboratory continues to tailor this system for various transit and other critical infrastructure environments.



The 1995 terror attacks in Tokyo, Japan, in which sarin gas was released at multiple points in a busy subway system, can be described as a turning point in critical infrastructure protection. This deadly event and the slow, chaotic response effort that followed brought worldwide attention to the vulnerabilities in high-traffic metropolitan transit systems. It took more than 75 minutes for Tokyo authorities to gather information on the nature of the attack and to form a coordinated response; during which time, many of the 12 deaths and more than 1,000 reported injuries might have been prevented.

Impetus for a Solution

As a result of the U.S. national security concerns brought to light by the Tokyo sarin incident, the U.S. Department of Energy's (DOE's) Argonne National Laboratory and Sandia National Laboratories – in collaboration with the DOE's Chemical/Biological National Security Program (now Department of Homeland Security Science and Technology Directorate) – became the focus of research into improving emergency response capability in national critical infrastructure. Established in 1946, Argonne is one of the largest of the DOE centers for research and development in numerous areas of science and engineering, including matters of national security.

In 1998, Argonne received funding from the DOE to develop an early warning detection and response system to safeguard public locations from chemical and biological terrorist attacks. This became known as the Program for Response Options and Technology Enhancements for Chemical/Biological Terrorism (PROTECT). Its primary objective was to significantly reduce the time required to form a coordinated response to an incident, potentially saving lives.

Anatomy of PROTECT

The PROTECT program was designed as an automated hardware and software system to provide both early warning and response management in the event of an incident. By integrating an array of chemical, biological, radiological, nuclear, and explosive (CBRNE) sensors, PROTECT provides onsite personnel and emergency responders with accurate information about airborne attacks in large, complex public indoor spaces. Command, control, and communications are coordinated through Argonne-developed software, Chemical Biological Emergency Management Information System (CB-EMIS), which integrates sensor

data, mapping, train location, and atmospheric data to provide comprehensive, real-time situational awareness. The software is also equipped with advanced dispersion modeling capabilities, which provide facility authorities and responders with critical information on potential consequences of airborne threats both above- and below-ground. When an alarm is triggered, the system provides responders with recommended actions based on a complex set of conditions.

Evolution of the System

In late 2001, after three years of initial development, the PROTECT system was first tested in an exercise in a major U.S. subway system. In partnership with an urban transit authority, the Federal Transit Administration, and the National Institute of Justice, smoke tests were conducted to characterize and model airflow, and a detector array was installed to evaluate detector performance in the harsh environment of a subway station. The exercise demonstrated that the combination of rapid detection and networked communications could reduce the response time from an estimated 31 minutes down to only five minutes. This significant reduction in coordinated response time is essential in the effort to limit human casualties.

With this documented success, the government sought to extend the benefits of the PROTECT program to other critical infrastructure applications, particularly urban transit systems. The Federal Transit Administration oversaw the initial transfer of the PROTECT technology to interested jurisdictions by offering workshops for transit authorities and training seminars in the use of the detectors and command-and-control software. Security considerations prevent the identification of the major metropolitan areas where PROTECT has been installed, but these transportation systems represent some of the largest and most challenging environments in the United States.

In 2002, additional chemical sensors and an automated digital closed-circuit television system were integrated into the CB-EMIS program. The closed-circuit television integration enhanced the system with the ability to automatically point video cameras toward the location of a detector alarm, providing important visual confirmation to system operators in order to verify conditions at the site of the alarm and to potentially mitigate false alarms. With these additional improvements and completion of a multi-station subway system test, the PROTECT program became fully operational in 2003.

In 2007, Smiths Detection was selected by Argonne to commercialize the PROTECT program. The company engineered and deployed the system into additional urban transit systems as well as several other critical infrastructure applications. In 2016, the PROTECT commercialization license was assigned to KD Analytical Consulting Inc.

Success & Improvements

In the ensuing years, PROTECT has seen continuous improvement in both the hardware and software components of the system. Numerous new detectors have been integrated with CB-EMIS. Recent advances in CBRNE sensor technology provide improved speed and accuracy of detection and offer greater reliability of the system as a whole. At the same time, Argonne

engineers have made significant strides in applying a scientific, whole-system approach to reducing false alarms. The CB-EMIS command-and-control software is continuously updated, and has been integrated with a number of physical security information management systems in order to accommodate existing infrastructure and security management operating procedures at each site where the system is implemented.

The PROTECT system is currently in use in several major metropolitan subway systems, covering a ridership of more than 200 million people per year. The system's success lies in its integrative approach to the problem of emergency management in complex interior infrastructures. The combination of sensitive detection devices and automated camera surveillance enable facility operators to quickly confirm the validity, nature, and scale of the release of a threat agent. With the aid of the CB-EMIS software, they can tailor an appropriate response in coordination with an ongoing stream of relevant situational information. Real-time data can be sent securely to responders in the field and to surrounding emergency operation centers.

In addition to its ability to greatly reduce response time and provide responders with detailed situational awareness during a chemical event, PROTECT offers other benefits to facility operators and emergency responders. The system's detailed, real-time surveillance capabilities – particularly the sophisticated video system – have proven useful for law enforcement and firefighters in dealing with many types of incidents involving fire, smoke, unknown substances, and suspicious packages as well as a wide range of criminal activities including bomb threats.

Although the PROTECT system is highly automated, it requires diligence and planning in order for an implementation to work effectively. Important factors include: engineering study of the infrastructure, airflow, and traffic patterns; response preplanning and development of standard operating procedures; training and drills; and coordination between onsite personnel and responders.

The Future of PROTECT

The scientists and engineers who developed the PROTECT program envisioned a broad range of applications beyond urban mass transit subway systems. These additional applications included single- and multi-modal transportation facilities such as: airports, trains stations, and bus terminals; high-value buildings and event facilities; as well as temporary installations for high-threat events and remote locations. Today, Argonne's [Global Security Sciences division](#) is tailoring the PROTECT system for use with both smaller and larger sensor sets in commercial and other building infrastructure environments.

Ian Schaefer is director of marketing for KD Analytical, a company that provides threat assessment, system engineering, technical support, maintenance management, and training to critical infrastructure protection and chemical, biological, radiological, nuclear, and explosive (CBRNE) response teams at local, state, and federal levels. He serves as product manager for the company's CBRNE maintenance management software-as-a-service, ReadiTrak™, and as a technical lead on projects with mission-critical software components. KD Analytical currently manages maintenance of the detection equipment in one of the PROTECT mass transit installations, and is the exclusive licensee of Argonne National Laboratory's CB-EMIS Software.

Lockdown at Washington College

By Rodrigo (Roddy) Moscoso

When the decision was made to cancel classes on Monday, 16 November 2015 the week before the upcoming Thanksgiving holiday break, Public Safety Director Gerald (Jerry) Roderick drew upon his many years of experience and planning on how to deal with a possible threat to Washington College campus in Chestertown, Maryland.



Following the Virginia Tech shooting in 2007, most colleges and universities have taken significant steps to improve their preparedness to various threats and, in particular, the threat of an active shooter on campus. Although Washington College is a small liberal arts college on Maryland's Eastern Shore with 1,500 students, it faces no less of a threat from an armed person than does a larger school. Engaging all supporting elements of a campus community is critical to ensuring that the response to such a threat is both comprehensive and coordinated.

Threat to Students

Roderick has worked at Washington College for 33 years and, 10 years earlier, helped to create the campus's Emergency Operations Group (EOG), which is charged with ensuring the safety of students and staff during a manmade or natural threat. At that time, he knew that one of his students had left campus and returned to his parents' house in Pennsylvania, where he had possibly acquired a firearm and then fled. Knowing that the student was distraught and facing disciplinary action at the college – and that a return to campus was possible – the decision was made to lockdown the school.

“We were very unprepared nine years ago, when we first began our training as the EOG,” said Roderick in a telephone interview on 1 March 2016. “We brought together first line supervisors as well as senior professional staff who had previously never interacted,” he continued. With a common mission of protecting students, the EOG developed training for a group of people who are neither first responders nor knowledgeable on incident command. A good portion of the training focused on educating staff on how to make decisions on their own during a crisis. “You have to train [staff] that the key people are not always going to be in the same room, so staff has to be ready to act on their own when necessary while we [public safety staff] are actively working the threat,” noted Roderick.

During the lockdown on Monday, the EOG convened at a preplanned off-campus location where they had trained before. While Roderick worked with local law enforcement to set up a perimeter around campus, the rest of the EOG focused on keeping the students safe, fed, and supported while sheltering in place throughout the day. With the state police and the Federal Bureau of Investigation offering support, an investigate group of more than 20 people quickly came together. In addition, the media represented another group that wanted access to campus, which public safety personnel needed to restrict for the safety of the press and the students.

By the end of that day, Roderick and the EOG were transitioning to “recovery mode” and planning for the school to open normally on Tuesday while the law enforcement investigation continued – primarily off campus. “However, on Tuesday morning at 7:00 a.m., I received disturbing information that directly led to a decision the next day to close the school entirely through the Thanksgiving holiday week.” Suddenly, a typical short-term lockdown was going to stretch to more than a week and, in doing so, present new challenges to staff and students.

The decision to start the Thanksgiving break early (it was originally planned to begin the following Wednesday) alleviated the need to support the majority of the student body who were now headed home. However, international students who planned to remain on campus during the break, and others whose travel plans did not allow them to leave school a week early, were stuck. “This meant that we had at least 150 students that we had to find homes for off campus,” noted Roderick. Fortunately, the community of Chestertown, Maryland, is tightknit, and places for the remaining students were identified quickly, including some who were taken in by college employees.

Sadly, the threat ended when the body of the student was found in Pennsylvania on Saturday, 21 November 2015, who had died from an apparent suicide. The college remained closed until the Monday after the Thanksgiving break, with essential staff working to recover from the lockdown and prepare for the reopening.

Lessons From the Lockdown

Roderick noted several takeaways following the two-week event. “We became so focused on the crisis that we were not paying enough attention to the ‘ripples’ that were affecting the surrounding community. When you have 10 police cars at every entrance to the college, it made other folks in the area very nervous,” he said. Without specific information on what the threat was, schools and businesses decided to close and even hospitals began locking their doors. “There was a big void in the messaging that was going out to our community. We have now invited the local emergency commander [in Chestertown] to join the EOG, so they have better information on what is happening on campus,” he continued.

Another lesson learned was that, “We were dealing with an incident that had multiple jurisdictions involved – local, state, and federal agencies – including multiple investigating groups, and even people from the suspect’s hometown were in lockdown,” said Roderick. “And the suspect’s hometown investigating teams were releasing information that we were not, which made it appear that we were not coordinating or even aware of certain facts. However, it was simply our local decision to not release certain information. This demonstrates the need to coordinate as much as possible on information dissemination, which can be a challenge,” he added.

Finally, Roderick noted the value of constant communication with the student body, faculty, and staff. He made sure that the College’s public information officer



**Jerry Roderick, Director of
Public Safety, Washington
College**

issued regular, nearly hourly updates were posted on the college website in the first days of the lockdown, as well as through automated notification tools, such as [e2Campus](#). This communication now includes more of the local community through the EOG.

Although Washington College ultimately received questions from the press and others who asked if the decision to close the school for such an extended period was the right one, Roderick remains unapologetic. “I can afford to lose class days, but I can’t afford to lose students.”

Rodrigo (Roddy) Moscoso is the executive director of the Capital Wireless Information Net (CapWIN) Program at the University of Maryland, which provides software and mission-critical data access services to first responders in and across dozens of jurisdictions, disciplines, and levels of government. Formerly with IBM Business Consulting Services, he has more than 20 years of experience supporting large-scale implementation projects for information technology, and extensive experience in several related fields such as change management, business process reengineering, human resources, and communications.

The Complexity of Credible Coverage

Getting it fast and getting it right go hand in hand. The new video from the Center for Public Safety Innovation (CPSI), called “Law Enforcement & Media Today: The Complexity of Credible Coverage,” shows journalists how to get the best information from law enforcement when time matters.



Stan Rhoads, Moderator

Harold Rochon, Captain, Detroit Police Department

Yolanda Fernandez, Community Awareness Manager, St. Petersburg, Florida, Police Department

Lane Michaelsen, Group News Director, Sinclair Broadcast Group

Scott Libin, Fellow, University of Minnesota School of Journalism and Mass Communications,
Radio Television Digital News Association Ethics Committee Chair

See also: [“Breaking News.” March 2016 edition of the *DomPrep Journal*](#)

Active Shooter – When Lockdown Is Not Enough

By Rodney E. Andreasen

Law enforcement officers, paramedics, and other responders have received extensive training in dealing with active shooters and the wounds resulting from active shooter incidents. However, the potential force multipliers in all these attacks that are just beginning to receive attention are the potential victims at the scene.



The frequency of active shooter incidents seems to have increased over the past few years, as revealed in the 2013 Federal Bureau of Investigations (FBI) [report on active shooters](#). As indicated in the report, no organization is safe, and any organization has a chance of being the target of these acts. Law enforcement, as well as other first responder, agencies have done excellent jobs in developing response options as well as medical survival techniques. However, much more can be done to better prepare for such threats.

A Growing Need to Train Citizens

Training available for citizens has lagged behind, even as programs to do such have continually evolved. In many cases, there is an attitude that an active shooter cannot be stopped or that it is the job of law enforcement to neutralize such threats. Although this has been the case in numerous incidents, [FBI statistics](#) indicate that 60 percent of active shooter events are over by the time law enforcement or other first responders arrive. Coupled with the fact that the arrival time of law enforcement and other responders averages 5-6 minutes or longer, the number of potential victims multiplies.

Issues surrounding citizen training have hampered measures that would ultimately save lives. One of these issues involves a reluctance to conduct comprehensive trainings to prepare individuals to survive active shooter events. Many organizations require personnel to sit through a short presentation on active shooters only to be given the basics of an active shooter incident, related statistics, and a rudimentary explanation of what they need to do. In some cases, the training involves the following steps to ensure personal safety: go into lockdown (lock doors if possible), turn out the lights, pull the shades, hide under desks, and silence cellphones. These passive options are not wrong, but can become so when no other options are provided.

Actual implementation of measures are, in most cases, never taught or employed within organizations. Current literature and numerous private training companies recommend having more than one option when dealing with active shooters. For example:

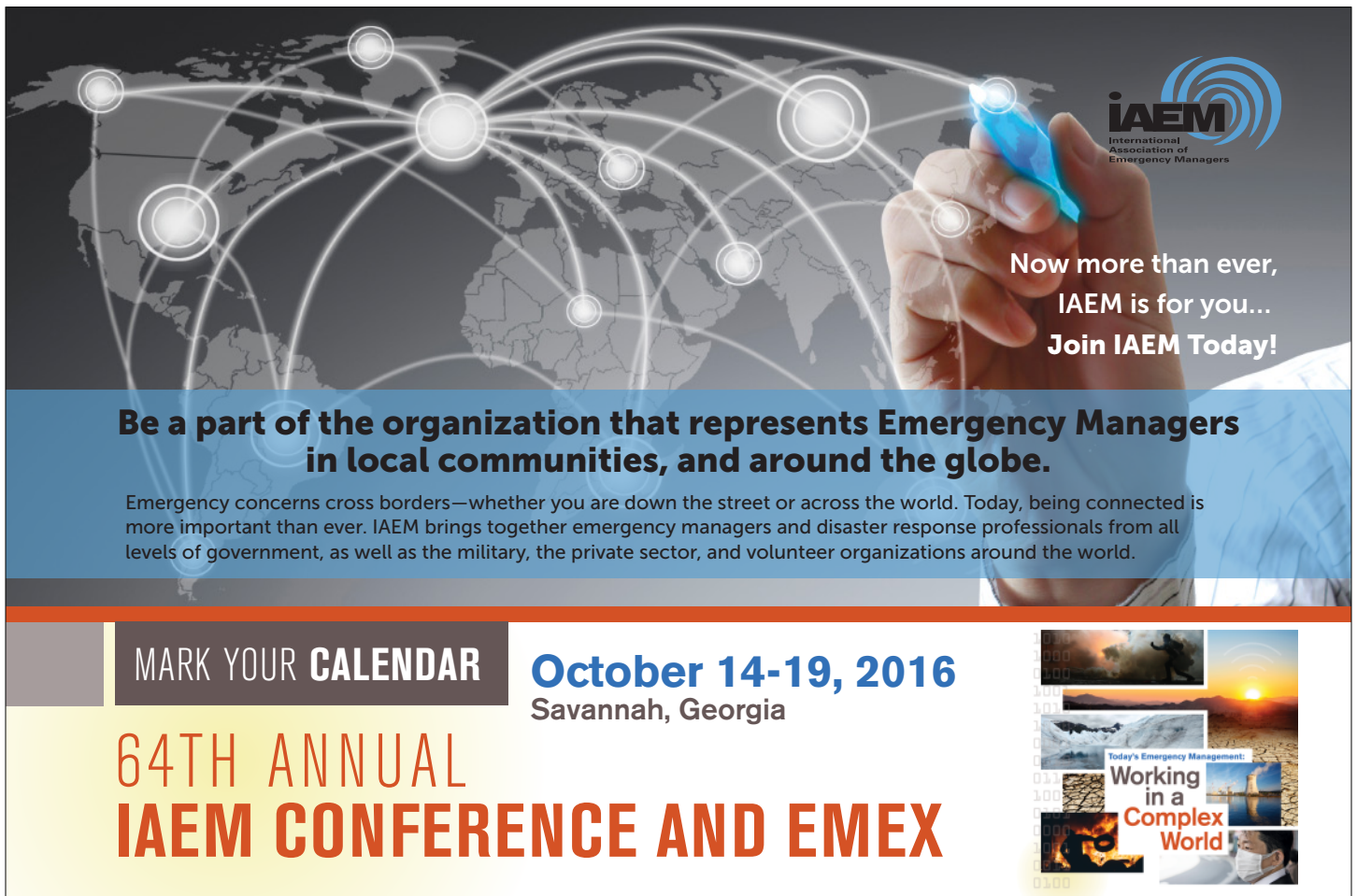
- [Developing High Quality Emergency Operation Plans for Houses of Worship](#)
(p. 28)
- [Guide for Developing High Quality School Emergency Operations Plans](#)
(p. 63)

- [Planning and Response to An Active Shooter: An Interagency Security Committee Policy and Best Practices Guide](#) (pp. 18-23)

Although many organizations still embrace the lockdown-only procedure because it is a quick and easy way to stop or delay a shooter’s attempts, this is not always the case. Questions remain about: what would happen if the lockdown fails; what would happen if the active shooter is able to breach the area that is currently in lockdown; and what options victims would have. To answer these questions, two specific incidents represent the impact of not having an options-based approach.

First was the 1999 Columbine High School shooting. The 9-1-1 tapes of the teacher in the library recorded her desperately trying to protect her students by telling them to stay on the floor and under the tables. She was not wrong in what she was telling the students to do because that is all she knew to do, which is reminiscent of the days of the Cold War and the “[Duck and Cover](#)” drills. However, as a result, the students became stationary targets for the shooter.

The second incident was the 2012 shooting at Sandy Hook Elementary School. A [report released in November 2013](#) by the Attorney General Office of the State of Connecticut revealed



The banner features a world map with glowing nodes and connecting lines, symbolizing global connectivity. A hand is shown holding a glowing blue pen, pointing towards the map. The IAEM logo is in the top right corner. The text is arranged in several sections: a headline, a sub-headline, a paragraph, and a large call-to-action section at the bottom with a collage of emergency-related images.

IAEM
International Association of Emergency Managers

Now more than ever,
IAEM is for you...
Join IAEM Today!

Be a part of the organization that represents Emergency Managers in local communities, and around the globe.

Emergency concerns cross borders—whether you are down the street or across the world. Today, being connected is more important than ever. IAEM brings together emergency managers and disaster response professionals from all levels of government, as well as the military, the private sector, and volunteer organizations around the world.

MARK YOUR CALENDAR **October 14-19, 2016**
Savannah, Georgia

64TH ANNUAL IAEM CONFERENCE AND EMEX

Today's Emergency Management:
Working in a Complex World

how lockdown was not adequate in an active shooter situation. The school was already in a lockdown mode when the active shooter began the rampage. The attacker merely shot out the plate glass window on the side of the door that was secured and entered the school to commit the crimes. Again there was no wrong in this because this was simply the way it had always been done. This type of incident had never happened there before.



Option-Based Training Programs

Although there is no silver bullet approach to all active shooter events, citizen training can go beyond rudimentary basics to truly prepare all those within a respective organization to survive an active shooter incident. An option-based approach is, at present, the best answer for preparing personnel to survive an attack. The highly successful program developed by the city of Houston called “Run. Hide. Fight.” is an excellent starting point for developing an option-based program. However, this approach should be expanded to include other trainings as well.

In much of the recent literature released by the U.S. Department of Homeland Security, the option-based approach is the common theme, but could be expanded to provide more opportunities for survival in these situations. New programs should use a dual-track approach to be more effective. The first track provides all the basic options to employ in case personnel find themselves in an active shooter situation. Suggested training topics should include those outlined in the Federal Emergency Management Agency’s (FEMA) [*Guide for Developing High-Quality School Emergency Operations Plans*](#), which include how to lockdown or evacuate when possible, as well as how to notify personnel of the active shooter’s presence. Other subjects that should be discussed include, but are not limited to, how to barricade and, as a last resort, fight. All are recommended by the previously mentioned document and should be viewed as the baseline document for the second track.

The second track involves the actual hands-on application of these techniques in simulated situations. Again, FEMA’s guide indicates that training and practice are the keys for successful employment of these options. By using a dual-track training process, the skills needed to perform the operation of active shooter survival becomes second nature. Training on numerous options can help people who find themselves in this situation disrupt the active shooter’s path and cause the shooter to take time contemplating the next move. In most cases, these attackers are not targeting specific people, but rather trying to inflict as much harm to people as they can. Removing the opportunity from the crime triangle – capability, opportunity, and desire – disrupts the shooters linear process

and reduces the possibility of the attack occurring. The additional time needed to search for targets consequently provides more time for the arrival of law enforcement personnel.

Training & Practice for Success

Although many may feel that the ultimate responsibility for this training should fall on law enforcement, emergency management, or other identified organizational security specialists, this is not always the case. Numerous commercial programs exist today that provide train-the-trainer instruction and should be sought by those previously mentioned. Many of these programs build off the basic “Run. Hide. Fight.” protocol and utilize a dual-track process. Additionally, materials provided through the U.S. Department of Homeland Security provide a starting point for development of an internal training program for organizations that a training specialist could develop.

Regardless of the method chosen, some effort must be initiated to start the process. For the program to be a success, practice is needed to make this a process that becomes automatic and part of the everyday culture. Just like fire and tornado drills have become the norm for many organizations – especially schools – active shooter drills should become part of the organizational process with support from senior management.

Whether someone trained in an option-based response to an active shooter could make a difference or even stop an active shooter is evidenced in a 2015 incident aboard a French commuter train. Three Americans (two of which were military servicemen) travelling together were able to take down an attacker bent on a mass killing with a pistol and a fully automatic assault weapon. The attacker was stopped when the three passengers made a conscious decision to do something, and the fight portion of an option-based response was employed. The shooter was only able to inflict one gunshot wound and other nonfatal injuries before being subdued. The result was a team effort by the three persons to engage the shooter. They had options.

The lessons taught in the black-and-white 16-mm film’s “Duck and Cover” drills in 1951 may have only provided limited protection against an indirect nuclear attack, but there is a key lesson to remember from that film. For those who grew up in the era of the Cold War, the threat was real and measures were taken to learn and practice those drills in school – a dual-track approach. The lessons became second nature and, more than 60 years later, are still remembered by many. Unlike the nuclear attack that never happened, the active-shooter scenario is a real threat that has occurred and will occur again. It is time to resurrect the dual-track approach of the 1950s to address the active shooter preparedness needs of today.

Rodney E. Andreasen, MS, MS, MA, FPPEM, CEM, is currently the emergency management director for Jackson County, Florida, and has served in that capacity for 15 years. He served 21 years in the United States Air Force in a variety of assignments in the United States and overseas. He retired from active duty in 1999 with the rank of master sergeant. In 1999, he was selected to develop trainers and training programs for the Florida Department of Revenue. In 2001, he was selected for his current position. He is a graduate of the University of Southern Mississippi with a Master of Science degree in Technical and Occupational Education, Auburn University-Montgomery with Master of Science degree in Justice and Public Safety, and the Naval Post Graduate School with a Master of Arts degree in Security Studies-Homeland Security and Defense. He is a certified Florida Professional Emergency Manager (FPPEM) and Certified Emergency Manager (CEM).

Our commitment to **BioDefense**
has allowed us to be ready
for the **Ebola outbreak**
in West Africa.

Now, with the **FilmArray system**
and our reliable **BioThreat Panel**,
we are able to test for 16
of the worlds deadly
biothreat pathogens
all in an hour.

Now That's Innovation!



Learn more at www.BioFireDefense.com

