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EMERGENCY NOTIFICATIONS FILTERED AS SPAM BY AOL

Emergency managers in hurricane-prone Indian River County, FL, thought e-mail was the ideal vehicle for getting severe weather alerts out fast and to the greatest number of people. "In the 16 years I've been in this office, it is the number-one thing that best informs the public," says Nathan McCollum, the county's emergency management coordinator.

What the county didn't know was that AOL was tagging the emergency messages as spam, and the warnings never reached their intended audience.

Last year's unusually busy hurricane season, during which four major storms hit Florida, meant more frequent alerts than usual for the 4,200 people who signed up for the county's e-mail alert service.

According to Basil Dancy, a county computer software engineer, the large volume of e-mails sent out in that brief time frame was similar to the pattern used by spam senders. AOL's e-mail filter interpreted the notifications as spam and blocked their transmittal.

Indian River County emergency management is working with AOL to fix the problem. Meanwhile, it is getting the word out to AOL users that they should add the county's email account to their address books so the service won't block the messages. (Source: Associated Press, May 3, 2005.)

USFA STUDY SHOWS SMOKE ALARMS MISSING IN TWO-THIRDS OF DEADLY RESIDENTIAL FIRES

According to a new study released by the US Fire Administration, a branch of the Federal Emergency Management Agency (FEMA), nearly 3,400 people die each year in fires that occur at home. Michael D. Brown, Under Secretary of the US Department of Homeland Security for Emergency Preparedness and Response and FEMA's Director, called the report "alarming."

"Residential structure fires, the very place people should feel the safest, unfortunately account for the vast majority of fatal fires," said Brown. "What's most worrisome is that in a full two-thirds of these fires, smoke alarms are missing or not working."

According to the new FEMA report, structure fires accounted for 74 percent of the 3,300 fatal fires in 2002. Of these fatal structure fires, 94 percent occurred in residences. Arson was the leading cause of fatal residential structure fires at 22 percent, followed closely by smoking at 21 percent. There were 3,380 fire-related deaths in 2002, down slightly from other years. The report summarizes some of the major characteristics of fatal fires and is based on data from the National Fire Incident Reporting System (NFIRS).

"An unacceptable number of Americans are losing their lives and being injured by fires each year," said US Fire Administrator R. David Paulison. "We know that smoke alarms, escape plans, child fire-prevention programs, and residential sprinklers save lives. We continue to encourage everyone to take the steps necessary to ensure their homes are fire safe today." Smoke alarms need to be tested frequently, and batteries need replacing every six months. The US Fire Administration recommends that people change the batteries every spring and fall when they change their clocks. "Do some spring cleaning on your alarm to make sure it works when you need it most," concluded Brown. (FEMA news release, March 31, 2005.)

NLM INTRODUCES HAND-HELD HAZMAT RESOURCE FOR EMERGENCY RESPONDERS

The National Library of Medicine (NLM), a component of the National Institutes of Health (NIH), has announced the release of a personal digital assistant (PDA) software tool designed to help first responders when they arrive at a HAZMAT incident such as a chemical spill.
The Wireless Information System for Emergency Responders (WISER) provides the emergency responder with critical information on hazardous substances, including physical characteristics, human health data, and containment and suppression information. Employing the unique characteristics of a PDA, WISER is customized for easy navigation and quick access to key information required by first responders. To aid decision making, users can specify the role they are currently performing at the scene of an incident, and WISER organizes the critical information in a sequence most relevant to a first responder on-the-scene, a HAZMAT specialist, or an emergency medical specialist (EMS).

"First responders in general, and HAZMAT units in particular, must make decisions quickly in handling hazardous-materials incidents," says Dr. Jack Snyder, NLM Associate Director for Specialized Information Services. "They need accurate information about hazardous substances, emergency resources available, and surrounding environmental conditions to save lives and minimize environmental impacts. WISER provides this lifesaving service."

According to Snyder, WISER will be an indispensable tool for first responders in their efforts to combat the growing number of hazardous-materials incidents in the United States. Based on statistics collected by the US Coast Guard's National Response Center on all hazardous substances and waste released into the US environment, HAZMAT incidents have been increasing yearly since 1991, with approximately 34,000 incidents reported in 2004.

A useful feature of WISER is support for identifying an unknown substance. Using input about observed physical properties of the unknown substance, along with reported symptoms and observable signs among victims, WISER can help the user narrow the range of substances that may be involved in a specific incident. As the emergency responder selects observed properties and symptoms, WISER looks in its database for chemical substances that have these characteristics. The list of candidate chemicals decreases as additional information is provided, and WISER presents the user with a list of candidate chemicals at any point in the identification process.

The operational versions of WISER for Palm OS and for Pocket PC are now available without charge at http://wiser.nlm.nih.gov. More than 1,700 copies of the WISER software have been requested and downloaded. A desktop version will be available later this spring, and a Web-based version is also being developed.

NLM is collaborating with regional and local emergency response organizations and using their feedback as input for future enhancements to WISER. It is also being incorporated into training curricula, such as the Baltimore County, MD, Hazmat Team training program, the Illinois Fire Service Institute, and FEMA's Chemical Stockpile Emergency Preparedness Program. (Source: NLM press release, March 11, 2005.)

NIAID AWARDS WHOPPING $27 MILLION FOR BIOSHIELD RESEARCH

The National Institute of Allergy and Infectious Diseases (NIAID), part of the NIH, has awarded 10 grants and two contracts totaling $27 million to fund development of new therapeutics and vaccines against agents of bioterrorism including anthrax, botulinum toxin, Ebola virus, pneumonic plague, smallpox, and tularemia.

These awards are the first made by NIAID under the authority of Project Bioshield, which was signed into law on July 21, 2004. Project Bioshield gives federal agencies license to accelerate research on medical countermeasures against chemical, biological, radiological, or nuclear attack.

These first grants, which range in duration from 12 to 18 months, are designed to aid in the development of medical products against "Category A" agents—those biological agents considered by the Centers for Disease Control and Prevention to pose the greatest threat to national security.

According to Anthony S. Fauci, MD, director of NIAID, "These product development awards, focused on the most serious potential agents of bioterror, will help to rapidly translate laboratory findings into new therapies." (Source: NIAID press release, May 9, 2005.)
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INTRODUCTION

Local and state emergency management (EM) directors have many legal duties. These duties are based on specific EM law and other laws of general application, such as Occupational Safety and Health Administration (OSHA) law, contract law, personnel law, and government ethics law.

They also have the responsibility for purchasing systems and equipment that best meet the needs of their departments while staying within the confines of time and budget. This article will present guidelines for successfully negotiating EM contracts.

STATE EMERGENCY MANAGEMENT LAW

Every state has some form of EM law. Such laws typically relate to:

- setting up a state emergency or disaster management agency,
- specifying state and local organization roles in responding to disasters,
- assigning executive authority to declare a state of emergency,
- explaining special executive powers that result from such a declaration,
- allowing cooperation in the form of mutual aid with neighboring jurisdictions,
- drafting emergency plans and keeping them current,
- compiling and distributing a list of emergency duties for all officials, and
- documenting the chain of command for continuity of government purposes.

State EM statutes often address other aspects of disaster preparedness and response, assigning a broad and varying set of responsibilities to emergency managers. For example, in Indiana, emergency managers fulfill a variety of duties during all phases of EM and are also responsible for preparing and keeping emergency plans current, preparing and distributing a list of emergency duties for all officials, and documenting the chain of command for continuity of government purposes.

The definition of “emergency management” lays out the broad scope of the discipline’s responsibilities. In a general sense, it relates to the preparation for and coordination of all emergency functions other than those designated to military forces or other federal agencies to prevent, minimize, and repair injury and damage resulting from disasters. These functions include firefighting; police services; medical and
health services; rescue; engineering; warning services; communications; radiological, chemical, and other special weapons defense; evacuation; emergency welfare services; emergency transportation; infrastructure protection; and restoration of utility services. As is readily apparent, although the enumerated duties at the state level are limited, their scope is all-inclusive. Keeping EM plans current is another specific responsibility, and the failure to fulfill it may expose the emergency manager and his or her jurisdiction to liability.

**LOCAL EMERGENCY MANAGEMENT ORDINANCE**

The local emergency manager is obliged to understand and obey all relevant local ordinances related to his or her functions. Local EM ordinance serves a number of purposes:

- It “fills in the blanks” in EM state law.
- It creates a structure for governmental EM activities.
- It delineates the local line of succession.
- It specifies grants of emergency authority to the leaders of the unit of government.
- It provides a structure for EM activities.
- It acts as a teaching tool to help public employees understand their roles during a disaster.
- It provides legal support to the emergency operations plan.
- It ensures that proper steps are taken to save lives and protect property.

The local EM ordinance must also comply with the requirements of NFPA 1600 (March/April 2005) and National Incident Management System (NIMS) standards as well as other laws designed to prevent liability.

**CONTRACT LAW: PREVENTING LEGAL CLAIMS REGARDING PRODUCTS AND SERVICES**

Every emergency manager enters into contracts for purchase of goods and services. The basics of contract law are straightforward, consisting of three elements:

1. the offer; e.g., “I will sell you these goods or perform these services for this amount of money”;
2. acceptance; and
3. consideration (the fee paid for the services).

To facilitate mutual understanding, contracts are typically written rather than oral. A written agreement allows both parties to see clearly the subject matter of their bargain.

Difficulties arise when the parties do not have a mutual understanding of exactly what is offered or the nature and character of the consideration. One key thing to remember is that the party that initially drafts the contract will typically end up with a document reflecting his or her desires more than those of the other party. This is why emergency managers should, whenever possible and particularly with expensive purchases, see that their attorney drafts the contract. For some, this step is a given, as many units of government have standardized contracts for purchase of goods or services. Another tack is to take the contractor’s document and use pieces of it in crafting one’s own contract.

Frequently, though, contractors have standard contracts of their own that they will submit as the first draft. They may say that they always use this contract and threaten to walk if it is not used. In such cases, it is not a bad idea to let the contractor walk away from the deal. Remember, for the most part the purchaser has the upper hand in negotiations, because he or she has the money, and the contractor needs the work to prosper.

Sometimes, the contract officer will be tempted to use the contractor’s document as is, because it means
less work for that busy individual. One must be extremely careful in reviewing such texts and be ready to delete unacceptable language. These documents are often worded to contain indemnification requirements, waivers of inadequate performance, arbitration clauses, and other language that dilutes the obligations of the contractor. They may also include requirements that are contrary to state or local law. The emergency manager and his or her attorney or contract officer should carefully scrutinize the contents of standardized contracts, particularly when big-ticket items are involved. Modification of standard language is often in order in such situations.

**Performance standards**

One key part of drafting a contract for purchase of goods is performance standards. These are particularly important when the items purchased are being custom built. The emergency manager and the field expert need to get together to discuss in detail exactly what is desired and how it is expected to operate when installed. They then need to meet with the attorney or contracting officer to make sure the standards are written into the contract in complete form. If this preparatory step is properly taken, the emergency manager is much more likely to end up with the end product desired.

**Sidestepping political pressure in awarding contracts**

When purchasing a complex and expensive system, there may be political pressure to award different contracts to various people within the jurisdiction with the goal of “spreading the wealth.” Although this may sound like a good idea, in actuality it could be the cause of unending headaches. When a system such as a communications network is installed, all of its parts must work together properly for it to perform as advertised. If multiple contractors perform the work, they may all point fingers at one another if there is a problem and refuse to cooperate and address it. This can be expensive and politically embarrassing.

One good way to avoid this problem is to insist on a turnkey system with guarantees in the contract that it will perform as advertised prior to acceptance by the purchaser. To help ensure this, it is important to set up a schedule of partial payments that holds back a significant portion (typically 25 to 33 percent) until verification tests, possibly by a third party, have been performed to ensure the entire system functions properly.

When the actual product differs from the contents of a written contract, the party whose expectations are frustrated will have a number of legal options. First, there may be a cause of action for damages or specific performance. Second, the contract may be repudiated or cancelled. Third, if part of the contract has been complied with but some performance is contrary to the contract requirements, there may be payment for partial performance only.

**CONCLUSION**

State and local EM personnel have a broad range of duties, not the least of which is reducing their jurisdictions’ risk of liability. Following the contractual safeguards above helps ensure that EM support systems perform optimally and can protect EM departments and officials from potential legal action as well as professional embarrassment.

William C. Nicholson, JD, Adjunct Professor, Widener University of Law; Adjunct Professor, University of Delaware, Newark, Delaware (wcnicholson@widener.edu). Note: This article is for information only and does not constitute legal advice. For legal advice, consult your own attorney.
Gaining sponsorship: An effective strategy for reducing organizational resistance to emergency management response and planning

Neil Simon, BS, MA

INTRODUCTION

In the last issue of *Journal of Emergency Management* (March/April 2005), I discussed the social and psychological underpinnings of organizational resistance to emergency-management response and planning (EMRP). In this column, I’ll explore an effective technique for combating such resistance—namely, gaining community and organizational sponsorship.

One of the most significant challenges for emergency-management (EM) personnel is integrating EM concepts and services into the nuts and bolts of organizations. Gaining sponsorship within an organization or community reduces resistance while assisting in the integration of EM efforts. I found this to be true based on my own research and on numerous professional consultations and collaborations.¹

Specifically, gaining sponsorship involves:

- understanding the role of culture (organizational and community) in forming alliances;
- conducting an organizational landscape analysis (OLA) to develop an integration strategy; and
- identifying and aligning with key influential leaders in the community or organization.

THE ROLE OF CULTURE IN SPONSORSHIP

Before we can identify sponsors, we need to recognize that organizations and communities are composed of “mini” cultural communities. We are often so immersed in the culture and values of the communities in which we live and work that we are unable to step back and understand how they affect what we do and how we might learn to better work within them.

Fundamentally, all communities are created by people who share a vision and create alliances based on the personal needs and goals arising from that vision. These alliances created a set of dynamics that help found a community. For example, developers build bedroom communities because there is a group of people who subscribe to that particular vision of a neighborhood. Voters create ethnic communities because their vision limits membership to people in their particular ethnic group. Service and product communities build their customer bases by fostering and encouraging brand loyalty based on these visions.

Through shared vision, leadership is created and endorsed by the self-selected community. Leaders are responsible for creating perceived-benefit environments within their communities, which are based on endorsed philosophies. As an example, think about the formal way IBM conducts business as opposed to the informality at Apple or Microsoft. Think of the cultural differences between the Mennonite and San Francisco communities. Each
Table 1. Sample questions to reveal organizational landscapes in business and government

<table>
<thead>
<tr>
<th>Area of exploration</th>
<th>Business</th>
<th>Government</th>
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<tr>
<td></td>
<td>Possible questions</td>
<td>Possible questions</td>
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<tr>
<td>Corporate director</td>
<td>• What is the vision of the business?</td>
<td>• What is the purpose of the community?</td>
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<td>• What is the mission of the business?</td>
<td>• What services does the community want?</td>
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<td>• What is the vision of your EMRP unit?</td>
<td>• What is the community vision?</td>
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<td></td>
<td>• What is your EMRP unit’s mission, and how does it tie into the mission</td>
<td>• For what services is the community willing to pay?</td>
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<td>of the business?</td>
<td>• What is the vision of your EMRP unit?</td>
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<tr>
<td>Business functional and</td>
<td>• What is the purpose of the business?</td>
<td>• What form of government does the community have?</td>
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<td>political structure</td>
<td>• What services or products does it provide?</td>
<td>• What is the current political structure within the community?</td>
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<td></td>
<td>• What do you contribute to the work the business does?</td>
<td>• What has been the historical political structure within the community?</td>
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<td></td>
<td>• Who are the key leaders, and how do they contribute to the work of the</td>
<td>• What alliances exist within the community (people, businesses, other</td>
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<td></td>
<td>business?</td>
<td>politicians)?</td>
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<tr>
<td></td>
<td>• Who are the allies of the key leaders?</td>
<td>• What value do these alliances provide for you and your business?</td>
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<td></td>
<td>• What does the alliance do for the business?</td>
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<td></td>
<td>• Do the leaders and alliances value what you provide?</td>
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<tr>
<td>Formal and informal</td>
<td>• What does the business value?</td>
<td>• What are the norms of the community?</td>
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<td>norms and rules of the</td>
<td>• What are your rules about work? How does work get done?</td>
<td>• What does the community want the government to involve themselves with?</td>
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<td>culture</td>
<td>• What are the rules and values around information? Is information used</td>
<td>• To what degree?</td>
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<td>as part of the business currency or as a tool to achieve recognition</td>
<td>• What information does the community want from the government? What don’t</td>
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<td>or reward?</td>
<td>they want?</td>
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<td>• What place do you have in the workings of the business and what it</td>
<td>• What is not talked about in the community?</td>
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<td>does with its information?</td>
<td>• What does the community fear?</td>
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<td>Needs of leaders and</td>
<td>• Who leads the business?</td>
<td>• How is your service role perceived by your population? How is it</td>
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<td>influential people</td>
<td>• What are their needs?</td>
<td>accepted?</td>
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<td></td>
<td>• What are their issues?</td>
<td>• What frightens your community?</td>
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<td>• Who influences the leaders?</td>
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<td></td>
<td>• Which of the leaders are open to the services and products you have to</td>
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<td>offer?</td>
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<td>• Who do you know that could assist in making a connection with select</td>
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<td></td>
<td>leaders and influential people?</td>
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<td></td>
<td>• Who is in charge of your community? Who is elected? Who really calls</td>
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<td></td>
<td>the shots?</td>
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<td></td>
<td>• What are the needs of the “shot callers”?</td>
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<td></td>
<td>• Who politically supports your service?</td>
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<td>• What do the politicians need from you and your service?</td>
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<td></td>
<td>• What can you provide to the population that would help the politicians?</td>
<td></td>
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<td></td>
<td>• Who influences formal community decision makers?</td>
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example dramatically reflects a distinct culture.

In a functional sense, a community that has been in existence for some time organizes and creates internal systems that support its activities. These systems (work, support, leadership, laws, and services) create societies within the overall structure, each with its own unique set of rules. Specific people are responsible for the leadership, maintenance, growth, and safety of the community. It is from these defined internal systems that EM planning and response teams need to receive their direction. If they try to impose their will on the community, they will be defeated.

CONDUCTING AN ORGANIZATIONAL LANDSCAPE ANALYSIS

Most organizations and communities develop through basic planning methods set forth by the leadership. In business, the board of directors has a president or CEO, while a community elects its leaders at all levels (e.g., governor, county commissioner, town selectman). Planning goals often manifest themselves through written vision and mission statements; however, the goals and objectives of the community may be expressed through other formal and informal planning methods.

To understand the lay of the land in your organization or community, I recommend conducting an organizational landscape analysis (OLA). An OLA provides the critical information needed to successfully integrate EMRP into a community or organization and identifies the sponsors who will support it. Like planning goals, OLAs can be conducted formally or informally. I recommend a formal process so adjustments can be made to accommodate personnel or strategic changes. Formal documentation also provides a baseline for the community and enables it to chart its progress.

Generally speaking, OLAs are comprised of a series of questions that reveal key facts regarding corporate direction and that identify appropriate sponsors for EMRP and other projects (Table 1). Emergency planning personnel should obtain the approval of the organization prior to conducting the analysis because of the initial time and costs involved. (Once the initial analysis is conducted, reviews can take place on a scheduled basis at a fraction of the cost and time.) Tables 2 and 3 provide examples of summary OLA charts specific to business and EM that can be used to compile findings and responses.

<table>
<thead>
<tr>
<th>Systems</th>
<th>Business structure</th>
<th>Key leaders</th>
<th>Key needs and issues</th>
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<tr>
<td>Work</td>
<td>Marketing</td>
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<td>Financial</td>
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<td>Operations</td>
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<td>Support</td>
<td>Communication</td>
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<td>Library</td>
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<td>Quality</td>
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<td>Leadership</td>
<td>Board of directors</td>
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<td>Management</td>
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Table 2. Summary chart of a business landscape analysis: Identifying the needs of leaders and influential people

SPONSOR-SUPPORTED EMERGENCY RESPONSE AND PLANNING

After collecting and charting OLA responses, the EMRP facilitator can:

- determine the current status of EM planning and response in the community;
- plan a strategy to improve that position;
- identify the sponsor(s) needed to sanction changes and ongoing improvements; and
determine the common denominators among leaders.

This information will assist in determining the right strategy and tactics for the existing government or organization.

Once a sponsor is identified, he or she can address any concerns community members have about EMRP and help position the organization for effective and successful emergency planning. If a sponsor was used for conducting the OLA, you should check in periodically regarding the progress of the study. This will help establish a relationship and create an alliance within the organization. Later, the OLA sponsor may be a possible aid in strategy development and implementation. If there is no sponsor, then the EMRP facilitator can either conduct the OLA alone or search the community for an appropriate OLA sponsor; this approach, however, is much more challenging.

SELECTING A SPONSOR
Selecting a sponsor begins by identifying key leaders and people with influence in an organization. Ideal sponsorship includes support for EMRP on many levels and is created by promoting EMRP as a win/win situation—in other words, everyone gets something out of it. In sponsor selection, it is important to understand what it is you have that helps the sponsor personally and professionally. The OLA can be useful in identifying these personal-agenda items more quickly.

Due care must be given to agendas within the community, for personal and communal needs can stand in opposition to each other. When these needs are out of alignment, one side of the relationship makes out better than the other. Ultimately, the imbalance could limit the effectiveness of EMRP and, in the worst case, cause the demise of the program altogether as has been seen in several communities.

CONCLUSION
Conducting a formal OLA ensures a thorough understanding of the landscape of a business or community and, thus, its EM needs. The time and expense associated with this method leads to much higher returns in the long run. The basic steps of gaining community sponsorship—determining the organization’s values and direction, identifying key leaders, selecting a sponsor, and partnering with the sponsor to provide effective EMRP—create a foundation for emergency planning that can be implemented with the least organizational resistance, optimizing effectiveness whatever and whenever the crisis.

Neil Simon, BS, MA, Managing Partner, Incident Mitigation LLC, Southfield, Michigan (njsimon@incidentmitigation.com).

REFERENCES

Table 3. Summary chart of an EMRP landscape analysis: Identifying the needs of leaders and influential people

<table>
<thead>
<tr>
<th>Systems</th>
<th>Community support structure</th>
<th>Key leaders</th>
<th>Key needs and issues</th>
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</thead>
<tbody>
<tr>
<td>Foundation of the community</td>
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<tr>
<td>Community activities</td>
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<tr>
<td>Political/governmental structure</td>
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Practicing emergency management in institutions of higher education

Steven Charvat, MPA, CEM
Elenka Jarolimek, MUP

ABSTRACT

Due to the substantial economic losses in the recent decade resulting from natural and human-caused disasters, many US colleges and universities have established their own emergency management offices and departments. This review evaluates the University of Washington’s first year in establishing an emergency management office, the Federal Emergency Management Agency’s role in supporting college and university disaster coordination efforts through the development of the Disaster Resistant University program, and the future of emergency management programs at institutions of higher education.

INTRODUCTION

Over the past decade, colleges and universities in the United States have increased the development and delivery of courses, degrees, certificates, and other methods of instruction to professional emergency managers. However, there has also been a parallel movement for many institutions of higher education to practice what they preach. Due to the substantial economic losses in the recent decade resulting from natural and human-caused disasters, many colleges and universities have begun to establish and support their own emergency management (EM) offices and departments. There are unique challenges in dealing with colleges and universities that make it difficult to apply local government EM models to academic institutions of higher learning. With their own diverse populations, critical infrastructure and related hazards, and specialized resources many colleges and universities are considered a city within a city.

GROWTH OF UNIVERSITY EMERGENCY MANAGEMENT OFFICES

Although no independent survey has been conducted to quantify how many EM programs have been established, information is spreading via word of mouth through professional associations and list servers. The events of September 11, 2001, influenced the decision to develop programs that reduce the risks of disasters. In the immediate aftermath of the attacks, many higher education institutions reviewed their disaster plans and began to reconsider issues of safety and security.

The events that Pace University in New York City experienced as a direct result of the terrorist attack on the World Trade Center tested its readiness to deal with such a disaster. Its main Manhattan campus was only two blocks away from Ground Zero. Furthermore, its World Trade Institute program was operated from the 55th floor of the South Tower of the World Trade Center. Four Pace students and 40 alumni lost their lives. Days after the attack, air quality, water contamination, and the restoration of communications became chief concerns along with the resumption of operational and academic functions.

In the last decade, disasters have affected university and college campuses with disturbing frequency, sometimes causing death and injury but always imposing monetary losses and disruption of the institution’s teaching, research, and public service.

In June 2001, Tropical Storm Allison inundated the Houston area and its universities and colleges with 10 to 24 inches of rain. The University of Texas at Houston Medical Center was flooded with 22 feet of water, causing the hospital to close for the first time in its history and seriously disrupting its operations.
research efforts. The total losses were estimated at $2 billion.\textsuperscript{3}

Damage can result in significant losses that can be measured by faculty and student departures, decreases in research funding, and increases in insurance premiums. The experiences of Pace University and the University of Texas along with the impact of the 2001 Nisqually Earthquake on the University of Washington (UW) demonstrate that losses could have been substantially reduced or eliminated through comprehensive predisaster planning and mitigation actions.

The Federal Emergency Management Agency (FEMA) together with the University of California at Berkeley conducted a study of earthquake hazards and the economic consequences of potential losses at the Berkeley campus as a development component of the Disaster Resistant Universities (DRU) initiative. The study, *Economic Benefits of a Disaster Resistant University: Earthquake Loss Estimation for UC Berkeley*, found that structural and nonstructural damage could close from 50 to 70 percent of campus space for up to one year after a magnitude 7.0 or larger earthquake on the Hayward fault.\textsuperscript{4} Among the 17 campus buildings in which 75 percent of the research is concentrated, the same portion of space—50 to 75 percent—could be significantly damaged and closed after a major seismic event.\textsuperscript{4} Finally, one-third of the replacement value of the campus is in its contents—all highly susceptible to damage.\textsuperscript{4}

Although the loss to buildings and contents represents 30 to 40 percent of the replacement value of the campus, the greatest potential losses, in academic and regional economic terms, would result from a substantial earthquake that forced even a partial campus closure. Based on these findings, the study recommended that the campus consider operational needs in planning for building improvements, business resumption plans for all units, and nonstructural mitigation programs across the campus.\textsuperscript{4}

**UNIVERSITY SEEN AS CITY**

Universities are often considered as a city-within-a-city with their own diverse populations, critical infrastructures, and specialized resources. With billions of dollars collectively in annual private and public investment, these institutions deserve the attention of a comprehensive EM program similar to those provided in their neighboring communities, cities, and counties. At the UW, the weekday population between the hours of 9 AM to 5 PM is approximately 65,000 in .4 square miles.\textsuperscript{5} The population increases six times a year to approximately 73,000 during Husky home football games.\textsuperscript{6} In addition, UW generated $2.7 billion in revenue, which grants and contracts constituted 32 percent or $843 million in fiscal year 2003.\textsuperscript{5} People and financial resources are concentrated in a small area, of which is geographically divided by a body of water. Careful planning is required to avoid devastation by a future catastrophic event.

As a result of tumultuous events at the university and around the world, which included the Nisqually earthquake, fire bombing of the Urban Horticulture Center, the 9/11 attacks, and anthrax mail threats, the UW established its first Office of Emergency Management in 2003. Located at the Seattle main campus, the goal of the office is to coordinate campus emergency planning, mitigation, preparedness, response, and recovery efforts.\textsuperscript{7} Additionally, the Office of Emergency Management acts as the primary liaison between the university and other outside government (city, county, state) EM agencies and centralizes all campus-wide emergency/disaster plans, training, and exercises.

The UW is also following a national trend—the realization by many college/university administration officials that their campuses deserve the attention of a full-time professional staff dedicated to saving lives and preserving the missions of the institution. These trends include:

1. Developing more proactive activities on preparing for a large-scale disaster that could impact a large area of the campus. This goes beyond the basic fire drill by coordinating different operational units responsible for responding during an event in tabletop and simulated exercises.
2. Emergency information has been elevated to a higher priority. Now, instead of searching for the Web site, a number of colleges and universities have made it a priority to provide a direct link to emergency information from their home pages.

3. Academic institutions in the last two fiscal years have directly benefited from federal grants. Two grants were awarded to the UW in recent years that assisted in strengthening the EM program.

Disaster Resistant University program

In 2000, UW was selected by FEMA, now under the Department of Homeland Security (DHS), to participate in the national DRU program. Along with the University of California at Berkeley, the University of Alaska at Fairbanks, the University of North Carolina at Wilmington, Tulane University, and the University of Miami, UW was designated as a leader in campus emergency preparedness nationwide.

As a result of the $100,000 in program support funded through the FEMA grant, UW has developed a number of new and innovative programs designed to reduce or eliminate the impact of disasters on the students, faculty, staff, and visitors. These included completing a risk assessment, updating a campus emergency operations plan, conducting hazard awareness education, improving emergency response training, and outlining a business continuity planning process.

Urban Area Security Initiative

Robert Mueller, Director of the Federal Bureau of Investigation (FBI), warned in his congressional testimony to the US Senate in February 2003 of multiple small scale attacks against soft targets, which included schools and universities along with places of recreation and entertainment.

Having been identified as a location with a number of high risk targets, UW has received over $2 million in funding via the City of Seattle under the Urban Area Security Initiative (UASI) grant program. The DHS Office for Domestic Preparedness set the expectation that states and municipalities must strengthen their overall capability to respond to acts of terrorism involving chemical, biological, radiological, nuclear, or explosive (CBRNE) weapons. By awarding grants for the development of projects that would affect high-density, high-threat areas and for the protection of critical infrastructure, the intent was to continue to meet national priorities of preventing and responding to terrorist attacks.

ALL-HAZARDS APPROACH

The current funding reality is that support for EM programs is being diverted to counterterrorism programs at the national level. Therefore, it is important to emphasize that colleges and universities must adopt an all-hazards approach. According to William Waugh, Professor of Public Administration and Urban Studies at Georgia State University, “All-hazards means adaptable plans that provide the basis for dealing with a variety of hazards and disasters, including terrorism.”

As with most other colleges and universities where a very open environment and minimal security and access regulations exist, UW has to deal with a variety of different natural and human-caused hazards (e.g., earthquakes, severe storms, hazardous material release, or terrorism) and vulnerabilities (e.g., older facilities, transient populations, unique research). Yet results from the 2002 UW Hazard Identification and Vulnerability Assessment (HIVA) demonstrated that many of the hazards affecting the university could be diminished by basic mitigation steps. Given that resources are scarce at the local and state level, efforts and funds must be directed toward a more sustainable model that encompasses the all-hazards approach.

UNIQUE CHALLENGES

While managing a university EM program is similar to that of a municipality, there exist a number of unique challenges in dealing with an academic institution:

1. Selling the benefits of EM can be a challenge in the halls of learning but one that
is very much needed and appreciated. Academic acceptance of the concept of EM requires teamwork and consensus-building in an institution that makes many of its decisions via committees and workgroup structures.

2. Shifting the way of thinking during an emergency where decisions need to be made quickly is difficult within the consensus-building culture of a college or university.

3. A culture of disconnection exists between the academic and operational side of an institution in communicating the EM activities of the university. Currently, no formal standards or structures exist to invite the academic interests to participate in mitigation and preparedness efforts.

4. There are no national standards for business continuity and resumption planning in higher education institutions, whereas the private sector such as banks, telecommunications, and insurance industries are mandated by federal law to have such plans in place. The lack of policies or plans makes the research and critical-business functions particularly vulnerable to suffering huge losses, some of which may be unrecoverable. In the instance of the UW Urban Horticulture Center, on May 21, 2001, just after 3:00 AM, the center was fire bombed causing $4.1 million in damage. Faculty, staff, volunteers, and over 40 graduate students lost books, papers, research, and workspace. The four laboratories and much of the equipment were damaged beyond repair, along with library books, records, and computers.

5. The shortage of campus space can make it difficult to have a designated emergency operations center (EOC). In most instances, EOCs are multiple-use facilities or spaces used for classes or storage. At the UW, the EOC is shared with the Women’s Center and surplus storage and is located in a structure built in 1918 on pilings over water.

6. It is difficult to train staff and faculty where limited release hours and union bargaining rights need to be considered when offering specialized trainings. According to the UW release policy, an employee has a maximum of 24 hours per quarter released from normal work duties and must be compensated at the regular rate of pay to attend staff training and development programs designed to assist in developing or improving job skills. For instance, the UW EM office recently received a grant to provide Campus Emergency Response Team (CERT) training for up to 30 staff. To become a CERT member requires up to 30 hours of training. Although this is a pilot program, if it is expanded in the future, release hours and union issues will need to be addressed.

7. Training students to respond to disasters is a lost opportunity, because in two to four years they graduate and leave the institution. Yet students, as well as other members of the campus community, are particularly vulnerable to injury from events, either directly from falling objects during an earthquake or as a result of performing a heroic action while attempting to save lives. This reinforces the need to focus scarce resources where they have the most impact.

THE FUTURE OF EMERGENCY MANAGEMENT AT COLLEGES AND UNIVERSITIES

It is important to recognize the unique aspects involved in living and working near a college or university. Not only are these institutions responsible for
education, but, for many, they provide valuable research and countless public services to their respective communities. Many local emergency managers recognize and support the efforts of their counterparts who work at neighboring colleges or universities. A fully prepared institution of higher learning can be a formidable asset to its surrounding community because it can provide specialized expertise and skills as well as resources and facilities (e.g., shelters or emergency medical services).

As programs develop, the future of EM at colleges and universities needs to be further defined. Some recommendations that have emerged out of the first year of the UW Office of Emergency Management are:

1. Adopt an all-hazards approach: Although federal funding currently available to institutions of higher education has been focused on terrorism, most institutions should plan for all hazards.

2. Practice: Developing an EM response plan and testing it to the EOC provides great opportunities to find and modify the weaknesses in the response structure, and it provides an opportunity to train with other units within the campus structure.

3. Improve campus and community partnerships: It is important to involve other campus stakeholders in the process. This includes obtaining support from other administrators, faculty, staff, and students. Create a small advisory group made up of campus experts who are willing to actively participate and have a sense of ownership in the EM program. Also involve and inform the surrounding community, municipality, and county in campus EM activities. This provides added opportunities such as sharing their resources and networks.

4. Understand potential losses and manage the risks: The UW Office of Emergency Management intent is to work with other units on campus to prevent loss of life and injury from structural, nonstructural, or utility failures caused by natural or man-made disasters and to assist units in sustaining operations after an event. To accomplish these goals, the university must decide how to adequately measure risks.11

5. Encourage business continuity planning: In order to resume instruction, research, and public service activities within a certain time period after a disaster, it is imperative for all academic and operational units to undertake business continuity planning. This includes planning for alternate or backup computer information systems and vital records management, backup power and water supplies, and developing a structure to rapidly restore infrastructure.

6. Promote champions: There must be broader commitment from executive management personnel to support the programs, policies, and budgets; to implement many of the risk reduction strategies; and to advance structural and nonstructural mitigation projects institutionally.

**CONCLUSION**

UW has been the beneficiary of a national movement in which colleges and universities have established independent offices to coordinate disaster mitigation, preparedness, response, and recovery activities. Moreover, during the first year of its implementation, UW has demonstrated that it has the capability to effectively organize its resources and to develop an all-hazards approach when dealing with natural and human-caused disasters. Current trends in college and university EM programs include maximizing the opportunities to apply for funding at the national level, increasing emergency information sharing within the campus community, and developing more proactive methods.
for coping with large-scale disasters. Unique challenges exist when establishing a program that makes it difficult to adopt a community or city model.

Colleges and universities are repositories of knowledge and learning for EM. In addition, they provide some of the best tools available to assist in establishing or strengthening their own operational programs in order to become better prepared for any type of disaster.

Steven Charvat, MPA, CEM, Director, Office of Emergency Management, University of Washington, Seattle, Washington.


REFERENCES
Benchmarking emergency preparedness and response practices in the process industry

Nir Keren
Harry H. West
M. Sam Mannan

ABSTRACT

Process safety of a chemical plant encompasses several layers of protection. Control measures, shutdown systems, release absorption, accumulation of releases by dikes, and protection by barriers are layers of protection that are intended to prevent the development of an event. Emergency response is the next line of defense to control an event or, in case of loss of control, to minimize the consequences. However, a reliable response to an emergency event requires planning. This paper presents results of a benchmarking study of practices of emergency preparedness and response of 15 facilities in the process industry.

INTRODUCTION

Unanticipated circumstances may yield emergency events. Emergency planning adds a layer of protection to circumstances where prevention fails. The three major components of emergency planning are preparedness, response, and recovery.

This study presents the results of benchmarking emergency preparedness and response components of emergency planning. Ten chemical plants, three petrochemical facilities, a gas plant, and a pharmaceutical facility participated in this study. The number of processes in these plants varied from a single process gas plant to a 160-process site. The number of employees per site ranged from 27 to 25,000.

Emergency preparedness requires a multidomain deployment. Dennison briefly summarized OSHA process safety management (PSM) and EPA risk management program (RMP) requirements with regard to emergency planning. The preparedness process begins with identification of credible scenarios based on which consequence analyses are conducted and appropriate response strategies are developed. The analysis of resources and capabilities required for response to the emergency scenarios is part of the preparedness stage. This analysis examines the resources and the capabilities at the facilities, at neighboring sites, and in the local community. The development of resources is conducted according to the resource assessment and the level of cooperation amongst these parties and other emergency support organizations (Figure 1).

Because at least two parties are involved in emergency situations, the communication system becomes a crucial element to a successful execution of emergency plans in real-time situations as well as in drills.

The multidisciplinary nature of emergency events requires a clear hierarchy of command and a precise procedure. Training and the assessment of potential collaboration among the parties are essential in response to events. Quite often, preparedness programs are reestablished due to assessments of drills.

The development of physical infrastructure for emergency events consists of:

- development of shelters and safe havens;
- establishment of an emergency operations center (EOC);
- development of emergency communication capabilities; and
- development of an appropriate medical support infrastructure.
Emergency systems are developed parallel to the development of physical facilities. Typical emergency systems comprise:

- emergency power supply;
- emergency water supply;
- communication systems;
- emergency management (EM) support computer system;
- site and community alert systems;
- adequate incident command transportation; and
- appropriate control-room protection measures.

**METHODS**

To benchmark the emergency planning practices among the facilities in the process industries, researchers developed a questionnaire based on the *Guidelines for Technical Planning for On-Site Emergencies.* The questionnaire was distributed to more than 50 plants, out of which 15 facilities responded. The questionnaire is available at the Mary Kay O’Connor Process Safety Center, Texas A&M University Web site: process-safety.tamu.edu/publications/presentations/nir_questionnaire.htm.

The effects of the September 11th, 2001, events on the security of facilities in the process industries are still uncertain, and there is no consensus with regard to the way that emergency planning should address similar events. Thus, this work did not incorporate elements such as vulnerability assessments.

**IDENTIFICATION OF CREDIBLE SCENARIOS**

The process of identifying credible scenarios reveals events that emergency planning should address. A process hazard evaluation generates a list of potential incidents that can be assessed to determine the likelihood and consequences of each of the incidents. Then the incidents can be prioritized according to the associated risk.

For each incident, it is possible to determine the worst case scenario. For example, the loss of containment where all the material is being released instantaneously is a worst case scenario. However, the likelihood of development of such a scenario is extremely low. Preparedness for emergencies that consist of worst case scenarios requires enormous resources and may overwhelm the business operability of the facility. For each scenario, the outcomes should be listed, and the consequences and probabilities should be evaluated. The evaluation should consider facility management controls as well. For example, an event such as instantaneous loss of containment is a major concern in the process industries. However, measures such as control systems, overpressure reliefs, alarms, and mechanical as well as nondestructive tests reduce the likelihood of development of such scenarios.
Ninety-three percent of the plants in the survey considered worst case scenarios in the development of their emergency plans. These plants covered all three levels of magnitude of events: local, moderate, and catastrophic.

**IDENTIFICATION OF PROCESS AREAS WITH HIGH HAZARDS**

The majority of the facilities in the process industries have a large inventory of hazardous chemicals in many areas in the facility. The large number of chemicals and equipment can lead to an enormous number of possible scenarios resulting from a variety of hazards associated with combinations of equipment and chemicals. As noted earlier, it is impractical to plan for all emergencies. Therefore, it is necessary to analyze and prioritize the scenarios (Figure 2).

A number of techniques are available to identify areas of major hazards. Examining the plant allows responders to create a list of ranked areas that are analyzed to identify credible scenarios. However, the results of the analysis may vary if the analysis does not consider protection system failure. Only three of the plants surveyed included failure of protection systems in the process of ranking scenarios for emergency planning.

**IDENTIFICATION OF CREDIBLE SCENARIOS**

As with identification of areas with major hazards, a number of techniques are available to identify credible scenarios. The depth of analysis can vary from an informal review that involves intuition to a full process hazard analysis (PHA) session. Since identification of credible scenarios is one of the purposes of conducting a PHA, results from PHAs can be extremely helpful if this analysis has been done thoroughly.

The participants in the survey were asked to check which of the following methods best describes the process of identifying credible scenarios in their plants:

- using intuition;
- unstructured expert brainstorming;
- application of quantitative risk analysis methods; and
- use of the PHA to identify credible scenarios.

The majority of the facilities used PHA results for the process of identifying credible scenarios (Figure 3). Twenty percent of the plants conducted quantitative risk analyses. However, only one plant used quantitative risk analysis as its sole means for credible incident identification. The only plant that used intuition used quantitative risk analysis and results from PHA studies as well.

Consequence analysis is a thorough procedure that requires major efforts. Therefore, several commercial software programs were developed in the early- to mid-90s to support this procedure. The EPA, for example, offers free downloadable software on its Web site that can be useful for consequence analysis. However, the majority of the plants used other commercial software as well as customized software in order to comply with EPA and OSHA requirements. The survey reveals that none of the current plants are using customized software for consequence analysis. However, 27 percent are using simple calculations to assess the consequences of the various scenarios.
Only 20 percent of the plants use the free programs that are available on the EPA Web site. Long-term as well as short-term effects on the environment are being considered in the plans of 60 percent of the plants.

As noted earlier, the effects of September 11th, 2001, are not addressed in this study. However, the plants were asked whether their emergency program considered catastrophic scenarios involving terrorist attacks. Seventy-three percent of the plants responded positively.

**ASSESSMENT OF CAPABILITIES AND RESOURCES**

Assessment of resources and capabilities requires information on the magnitude of incidents that are considered credible scenarios (Figure 4). The resources that are required to deal with emergencies are based on assessments in three domains: on site, neighboring facilities, and the local community.

**EMERGENCY SUPPORT FACILITIES**

Emergency support facilities that are useful in emergency scenarios are:

- short-term shelters;
- safe havens—shelter with an alternative air breathing source;
- incident command post;
- EOC;
- media information center;
- medical support facility—other than first aid room;
- alternate water supply;
- community and facility alert systems;
- real-time modeling system;
- EM computing system;
- emergency power system; and
- meteorological instruments.

Of the participating plants, safe havens are available at 40 percent of the plants, an alternate water supply is available at 33 percent, and an EM computing system is available at 20 percent only (Figure 5).

**MEDICAL FACILITIES**

As for a medical facility other than a first aid room, three of the plants have the capabilities of a medical department. These facilities consist of medical doctors, nurses, and a variety of equipment to
support emergency situations as well as day-to-day needs. All plants with medical facilities consist of more than 5,000 employees. A third of the plants do not have medical support capabilities other than a first aid room. The medical capabilities of the other seven plants are a first aid room that can be used for stabilization of the patients until they are evacuated to the nearest local community medical facility.

An important parameter in emergency planning is the capability of the nearest hospital to handle massive casualties. Furthermore, a critical parameter for handling casualties in case of a release of hazardous material is that the local hospital is aware of the chemical threat posed by the neighboring facility. Ninety-three percent of the plants indicated that hospitals in their area could handle massive casualties. Hospitals near 80 percent of the plants were aware of chemicals in the facilities. Hospitals near the other 20 percent of the plants had a general idea only.

However, 87 percent of the plants increased their emergency net to include other medical facilities in addition to the nearest one. These plants also have a medical airlift available.

**FIREFIGHTING**

Onsite fire brigades are available at 93 percent of the plants, and their firefighters are available outside of the daytime shift as well. Local community fire brigades participate in site drills of all the plants. Only 40 percent of the plants have some form of an agreement for mutual assistance and equipment sharing with other facilities. However, 80 percent of the plants were equipped with at least a single fire truck. One of the plants noted that all their equipment was listed in a master database and was available to 17 other facilities, 25 fire departments, 11 law enforcement agencies, and 22 public safety agencies under a master mutual aid agreement.

**PHYSICAL FACILITIES AND SYSTEMS**

**Shelters**

According to the Center for Chemical Process Safety (CCPS), shelters provide passive protection for inhabitants when ventilation is off and all windows and other openings are closed, whereas safe havens provide an alternative air supply. Control rooms were used as shelters at 53 percent of the plants; however, safe havens were not available. At 27 percent of the plants, control rooms were used as safe havens in emergencies. In the remaining 20 percent of the plants, control rooms were used as shelters.

**Emergency operations center**

The EOC conducts assessments, develops response strategies, provides central communication, and directs activities in emergency events. The environment of the EOC allows EM staff to effectively supervise the activities and make decisions with regard to the development and escalation of events. The effectiveness of EM depends on factors such as the type of facility being used as an EOC, distance of the EOC from processes, and the design of EOC. Facilities that can be used as an EOC are a control room, a conference room, or a specially designed building.

Specially designed buildings were being used as EOCs by 80 percent of the plants. Thirteen percent were using conference rooms, and one of the plants used a different facility.

Eighty percent of the plants consisted of an alternative EOC. Two of the plants indicated that the
alternative EOC was located offsite. The EOCs were designed as shelters at 80 percent of the plants and as safe havens in the others.

The distance between the EOC and the processes was one of the factors that affected EOC sensitivity to the intensity of the events (Figure 6). An alternative power supply is crucial in emergencies, and all but one of the plants reported that an alternative power supply was available at their EOC.

**COMMUNICATION**

*Local agencies*  
Several elements in emergency planning are extremely crucial to an appropriate execution of emergency response. An effective communication system is one of these elements. The system is required to allow communication between the EOC and onsite and offsite responders, local agencies, corporate management, local medical facilities, employees, employees’ families, and the media. A convenient way to maintain communication is by maintaining an open channel between the local off-site agencies and the plant, as indicated in 93 percent of the plants studied. The majority of the plants coordinated and communicated their emergency planning with outside EM agencies and with the fire departments. Half of the plants involved the county emergency service directors in their plans, and 20 percent involved city management officials and the mayor as well.

*Alert system*  
A tone alert system was available at all the plants. Although tone alert system codes vary, the majority consisted of at least three codes: weather-related, major emergency, and evacuation.

Local communities can be informed about emergency situations in several ways. Tone alert systems and computerized telephone dialing systems are commonly used by half of the plants. Cable TV override systems can be used as an alert measure as well, however, this was employed at only 27 percent of the plants studied. The local authority is identified as another way to communicate the emergency to the local community by 27 percent of the plants.

*Metrics*  
Only 60 percent of the plants developed procedures to measure the effectiveness of their emergency programs. The procedure was used to measure the adequacy of existing emergency facilities, supplies, and equipment in 60 percent of these plants. Moreover, at all of these plants except one, the procedure was used to examine the effectiveness of coordination with offsite emergency response agencies.

Ninety-three percent of the plants reviewed their programs annually. One of these plants reported a semiannual management review as well. Moreover, any incident or near miss precipitated a discussion of the response plan.

![Figure 6. Distribution of distances of EOC from process areas.](image-url)
Table 1 presents the distribution of a variety of positions in the plants designated to assume the role of an incident commander (IC) during an emergency. The identification of the severity of an event, the decision with regard to the level of escalation, and the timing of this decision have a tremendous effect on the magnitude of the consequences. Misinterpretation of the magnitude as local instead of moderate, or as moderate instead of catastrophic, can cause significant loss and many casualties. Therefore, the personnel assigned to make this decision should be selected carefully. At 87 percent of the plants, the IC was responsible for this decision. Environmental health and safety (EHS) officers are responsible for this decision at the other 13 percent. At 93 percent of the plants, the decision on evacuation is in the hands of the IC. Only one of the plants nominates EHS officers to make this decision.

The responsibility of equipment updating and supply inventory is distributed as:

- EHS officers at 67 percent of the plants;
- emergency response personnel at 33 percent of the plants; and
- production managers at 7 percent of the plants.

Table 1. Distribution of a variety of positions in the plant as IC

<table>
<thead>
<tr>
<th>Position</th>
<th>Distribution (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency response officer</td>
<td>40</td>
</tr>
<tr>
<td>Production managers</td>
<td>27</td>
</tr>
<tr>
<td>Plant superintendent</td>
<td>13</td>
</tr>
<tr>
<td>EHS officer</td>
<td>13</td>
</tr>
<tr>
<td>Plant manager</td>
<td>7</td>
</tr>
<tr>
<td>Executives</td>
<td>0</td>
</tr>
</tbody>
</table>

Positions

Table 1 presents the distribution of a variety of positions in the plants designated to assume the role of an incident commander (IC) during an emergency. The identification of the severity of an event, the decision with regard to the level of escalation, and the timing of this decision have a tremendous effect on the magnitude of the consequences. Misinterpretation of the magnitude as local instead of moderate, or as moderate instead of catastrophic, can cause significant loss and many casualties. Therefore, the personnel assigned to make this decision should be selected carefully. At 87 percent of the plants, the IC was responsible for this decision. Environmental health and safety (EHS) officers are responsible for this decision at the other 13 percent. At 93 percent of the plants, the decision on evacuation is in the hands of the IC. Only one of the plants nominates EHS officers to make this decision.

The responsibility of equipment updating and supply inventory is distributed as:

- EHS officers at 67 percent of the plants;
- emergency response personnel at 33 percent of the plants; and
- production managers at 7 percent of the plants.

Table 2. Distribution of implementation of training subjects

<table>
<thead>
<tr>
<th>Training subject</th>
<th>Distribution of implementation (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification of hazardous situations</td>
<td>100</td>
</tr>
<tr>
<td>Identification of physical warning signs (e.g., smoke, smell)</td>
<td>87</td>
</tr>
<tr>
<td>Evacuation routes and shelter locations</td>
<td>100</td>
</tr>
<tr>
<td>Emergency reporting procedures</td>
<td>100</td>
</tr>
<tr>
<td>Usage of personal protection equipment</td>
<td>100</td>
</tr>
<tr>
<td>Identification of types of fire</td>
<td>93</td>
</tr>
<tr>
<td>Usage of proper fire extinguishing equipment</td>
<td>100</td>
</tr>
<tr>
<td>Drills on usage of personal protection equipment and fire extinguishing</td>
<td>80</td>
</tr>
</tbody>
</table>
provided the same training as other employees at 60 percent of the plants only. In general, EHS officers and personnel with similar positions were responsible for coordinating emergency preparedness training. As for training records, only one of the plants reported that these records were not kept. Eighty percent of the plants simulated crisis communication in their drills.

**SUMMARY**

The study revealed several interesting findings. Only 20 percent of the plants considered protection systems failure in the process of ranking scenarios for emergency planning. This process is sensitive to the presence of these systems. The results of PHA sessions were widely used as an input for the process of identification of credible scenarios. Although the EPA Web site offers free software to support consequence analysis, only 20 percent of the plants took advantage of it.

The analysis of resources and capabilities revealed that safe havens were available at 40 percent of the plants, and that an alternative water supply was available at only 33 percent of facilities. Plants that consist of more than 5,000 employees contained a medical facility with the full capabilities of a medical department. Eighty percent of the plants were equipped with at least one fire truck. Although alert systems, which directly warn the public about emergencies, are a convenient measure in terms of early notification, 27 percent of the plants in the survey depended on local authorities for the notification of the public.

Procedures that evaluate the effectiveness of emergency programs have been developed by 60 percent of the plants. However, 93 percent of the plants reviewed their program annually. Contract employees receive the same training as other employees in 60 percent of the plants.

Emergency planning practices vary, and there is a critical need to reach a consensus on recognized and generally accepted good engineering practices. This is true not only in the case of emergency planning but also in the case of other elements of the process safety management program. This effort is thus aimed at developing a benchmark of industry practices for different process safety management requirements. Benchmarking exercises may be repeated as practices change. Note that with new technologies and other advances, good practices will remain a moving target with the need for continual benchmarking of their applicability to the current timeframe.

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Harry H. West, Mary Kay O’Connor Process Safety Center, Chemical Engineering Department, Texas A&M University, College Station, Texas

M. Sam Mannan, Mary Kay O’Connor Process Safety Center, Chemical Engineering Department, Texas A&M University, College Station, Texas.

**REFERENCES**

ABSTRACT
A review of the literature shows that terrorism response plans exist but are lengthy. This is a concern because, in response to a weapons of mass destruction (WMD) incident, responders must be aware of the master plan. It is unlikely that all first responders will have a working knowledge of lengthy master plans; consequently, a situation could arise where responders would not be working together. To mitigate catastrophic inefficiency, a high-consequence event decision matrix was created to classify all high-consequence incidents at different severity levels and describe the necessary emergency actions first responders must employ.

INTRODUCTION
Two methods exist in combating terrorism. These methods are preparedness/prevention and response. Unfortunately, even with the most efficient system of terrorism prevention, a terrorist needs to be successful only one time out of 100. Luck and strategy could be the potential terrorist’s most powerful tools. Because of this inherent vulnerability, considerable effort must be placed in terrorism response planning.1

When considering issues of terrorism, the first question is how the nation responds to possible threats from weapons of mass destruction (WMD). In an effort to better define the threats that this country faces from WMD, the federal government has identified five main categories: biological, nuclear, incendiary, chemical, and explosive (B-NICE). The B-NICE acronym was developed to educate the public in WMD terrorism.2 The B-NICE view of WMD threats is both concise and publicly usable. Apart from these conceptual definitions of what to expect in a WMD terrorist attack, there are few practical resources available for use while they’re occurring.

EXISTING TERRORISM RESPONSE PLANS
The greatest weakness of terrorism response planning is that, despite the broad definitions provided by B-NICE, planning for every possible method of attack is nearly impossible. Prior to 9/11, very few members of the public considered the use of commercial airplanes as a means of attack.3 Since the form and time of the next terrorist attack cannot be predicted, response planning must be generalized so that the principles detailed in the plans can be extended to both foreseen and unforeseeable threats. The terrorism response planner must avoid producing plans that are too narrowly focused or so general that they are useless.

Existing emergency operations plans, like the Commonwealth of Virginia Emergency Operations Plan, Volume 8,4 are thorough examinations of all of the operational needs that must be met during a response to a terrorist incident. This plan in particular offers detailed checklists and organizational charts of operations. It also incorporates details about specific duties for Virginia government agencies that would be affected by a terrorist event.

However, concerns arise when there are no quick reference operation plans available for first responders. Though the plans appear comprehensive, a thorough review raises questions such as who will be responsible for managing a real-time mass evacuation and which office will be the sole source of information for the media and the public. Questions at this level of detail go unanswered in most terrorism response planning.
<table>
<thead>
<tr>
<th>Level</th>
<th>Category A</th>
<th>Biological</th>
<th>Category B</th>
<th>Nuclear surface burst</th>
<th>Radiological incident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 4</td>
<td>Category A pathogen. Moderate infection rate over a medium geographic area. Moderate casualties, low mortality. Minimal to moderate second generation infection. (2)</td>
<td>Category B pathogen. Moderate infection rate over a medium geographic area. Moderate casualties, low mortality. (4)</td>
<td>Category C pathogen. Moderate infection rate over a medium geographic area. Moderate casualties, low mortality. (4)</td>
<td>Detonation of a 11-50 kiloton yield nuclear bomb resulting in a 750 to 1,300 foot wide crater. Lethal for 50 percent of population. Thermal exposure 3 miles from incident. (1)</td>
<td>Release of between 350 R and 450 R total dose in the most concentrated area. Lethal for 5 percent of exposed within a month without medical attention. (1)</td>
</tr>
<tr>
<td>Level 3</td>
<td>Category A pathogen. High infection rate over a medium geographic area. Moderate to high casualties and low to moderate mortality. Moderate second generation infection. (1)</td>
<td>Category B pathogen. High infection rate over a medium geographic area. Moderate to high casualties and low to moderate mortality. (3)</td>
<td>Category C pathogen. High infection rate over a medium geographic area. Moderate to high casualties and low to moderate mortality. (3)</td>
<td>Detonation of a 51-100 kiloton yield nuclear bomb. Resulting in a 1,300-1,650 foot wide crater. Lethal for 50 percent of population. Thermal exposure 4 1/4 miles away from incident. (1)</td>
<td>Release of between 450 R and 650 R total dose in the most concentrated area. Lethal for 50 percent of population for those exposed without medical attention. (1)</td>
</tr>
<tr>
<td>Level 2</td>
<td>Category A pathogen. Moderate infection rate over a large geographic area with a heavy concentration in one or more areas. High casualties and moderate fatalities. High second generation infections. (1)</td>
<td>A Level 2 Category B incident is unlikely based on characteristics of a Category B pathogen.</td>
<td>Category C pathogen. Moderate infection rate over a large geographic area with a heavy concentration in one or more areas. High casualties and moderate fatalities. (2)</td>
<td>Detonation of a 101-500 kiloton yield nuclear bomb. Resulting in a 1,650-2,800 foot wide crater. Lethal for 50 percent of population. Thermal exposure 5 1/2 miles away from incident. (1)</td>
<td>Release of between 650 R and 1000 R total dose in the most concentrated area. Lethal for most people. (1)</td>
</tr>
<tr>
<td>Level 1</td>
<td>Category A pathogen. High infection rate over a large geographic area. High casualties and high mortality. (1)</td>
<td>A Level 1 Category B incident is unlikely based on characteristics of a Category B pathogen.</td>
<td>Category C pathogen. High infection rate over a large geographic area. High casualties and high mortality. (1)</td>
<td>Detonation of a 501 kiloton to 25 megaton yield nuclear bomb. Resulting in a 2,800-4,800 foot wide crater. Lethal for 50 percent of population. Thermal exposure 8 1/2 miles away from incident. (1)</td>
<td>Release of &gt; 1000 R total dose in the most concentrated area. Results in irreparable damage to central nervous system cells and death within hours to days. (1)</td>
</tr>
</tbody>
</table>

(1) = Relatively severe demand on resources and response capabilities; (2) = Relatively major demand on resources and response capabilities; (3) = Relatively moderate demand on resources and response capability; (4) = Relatively minimal demand on resources and response capability; (5) = Relatively minor demand on resources and response capability.
Table 1. The High-Consequence Event Decision Matrix (continued)

<table>
<thead>
<tr>
<th>Incendiary</th>
<th>Chemical</th>
<th>Explosive</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Level 5 incident unlikely because it is indistinguishable from &quot;normal&quot; everyday incidents.</td>
<td>Material does not indicate any atmospheric hazard. Splashes and direct inhalation are avoided. Applies to any size geographic area. (5)</td>
<td>A single, small-scale explosion near a sensitive target. Minor to moderate damage to target. Low loss of life immediately around explosion. (4)</td>
</tr>
<tr>
<td>Fires resulting in moderate to heavy damage of targets. Minimal structural damage to nearby buildings. (3)</td>
<td>Material will not adversely affect skin or be absorbed by skin. Type of chemical can be removed from atmosphere by air-purifying respirator. Atmosphere contains at least 19.5 percent oxygen. Applies to any size geographic area. (4)</td>
<td>Multiple explosions within close proximity to each other or a single medium explosion on multiple sensitive targets or a single universal target. Causing moderate to major damage to target(s). Causing moderate damage to nearby structures. (3)</td>
</tr>
<tr>
<td>Fires resulting in heavy loss of life immediately surrounding intended targets, moderate to major damage to targets, and minor structural damage to nearby buildings. (2)</td>
<td>Material requires high level of respiratory protection but less skin protection. Atmosphere contains less than 19.5 percent oxygen. Vapors, gases, or particles are not known to contain high levels of chemicals harmful to the skin. Applies to any size geographic area. (5)</td>
<td>Multiple explosions within close proximity to each other or a single large explosion involving multiple sensitive targets or a single highly sensitive target. Causing moderate to major damage to target. Heavy loss of life around target and moderate to major damage to nearby structures. (2)</td>
</tr>
<tr>
<td>Fires resulting in heavy loss of life immediately surrounding intended targets, major damage to targets, and moderate structural damage to nearby buildings. (1)</td>
<td>Material requires highest level of protection for skin, eyes, and respiratory system based on measured or potential high concentration of vapor, gases, or particles in a small to medium geographic area. (2)</td>
<td>Multiple large explosions within close proximity to each other on multiple highly sensitive targets or multiple universal targets. Heavy loss of life around target; major to severe damage to nearby structures. (1)</td>
</tr>
<tr>
<td>Fires resulting in heavy loss of life immediately surrounding intended targets, major structural damage to targets, and major structural damage to nearby buildings and extended geographic area. (1)</td>
<td>Material requires highest level of protection for skin, eyes, and respiratory system based on measured or potential high concentration of vapor, gases, or particles in a large geographic area. (1)</td>
<td>Multiple large explosions within close proximity to each other on multiple highly sensitive targets or multiple universal targets. Heavy loss of life around target, severe damage to nearby structures. (1)</td>
</tr>
</tbody>
</table>

Plans. Because of the unpredictable nature of terrorist attacks, planning specific responses is a daunting task. Even so, these elements must be addressed so that appropriate officials are aware of their roles in the overall response effort.

An additional question arises with terrorism response plans of this nature: do all the players who are involved in the response process have a working knowledge of the plan? Because of the length necessary for terrorism response plans like Virginia’s, it is unlikely. To remedy the problem, supplemental documents that consolidate the content of existing terrorism response plans must be provided to responders so that they have a working knowledge of the master plan.

METHODS AND RESULTS

Though it is nearly impossible to anticipate all the possible methods of terrorist attack, the methods for response are fairly straightforward: to provide immediate relief after disaster strikes and help individuals and communities recover from the effects. The High-Consequence Event Decision Matrix introduced in this paper is a possible resolution for some of the problems of terrorism response planning that have been illustrated in other plans or that have yet to be addressed in a singular document (Table 1).

MATRIX COMPOSITION

The matrix comprises four primary components. First, it attempts to resolve the ambiguity in the wide range of possible WMD threats. It accomplishes this by establishing definitions for five levels of severity of a WMD event. It then establishes each level of severity according to independent filters of information. The types of information for each filter should be available immediately or shortly after an attack occurs. The only exceptions to this are biological agents because of the time delay it takes for symptoms to appear and be recognized as evidence of a terrorist attack. When a presiding authority, either the president or a state governor, declares specifically what kind of incident has occurred, that declaration initiates the first responder and public actions. Once the terrorist incident is defined by the parameters of the decision matrix, responders
implement the second component, the emergency actions matrix (Table 2).

The third component of the decision matrix is the personal protective action matrix, which is a tool for first responders to indicate whether public protective actions like evacuation, shelter-in-place, community shielding, or decontamination are appropriate. Finally, the fourth component is a historical examples matrix that is a characterization of WMD events in the context of the event matrix. The historical examples matrix (not shown) helps the user determine the relative gravity of a WMD incident.

**MATRIX USE METHODOLOGY**

In order to understand how to properly use the event matrix, some direction is necessary. The matrix is organized into a series of rows and columns that incorporate severity data from the B-NICE categories. An understanding of the matrix is based on examining each column individually. Every column has its own separate filter for establishing the severity level of a terrorist incident. The implication of this is that the Event Matrix cannot be read from left to right. For example, a Level 4 biological event is not comparable to a Level 4 chemical event. To assist in the interpretation of the decision matrix in the appropriate top to bottom fashion, a colored guide can be applied. These colors would represent the relative demand on resources and response capabilities. Each individual color would represent either a minimal, minor, moderate, major, or severe demand. (Due to publication considerations, the coloring was replaced with a numbering guide for the matrix, but the colors would be reapplied for use in operations.) The language in the matrix pertaining to damage assessments and resource demands are deliberately vague to allow the use of the matrix in both major metropolitan areas and areas with lesser population density.

The organization of the row structure in the decision matrix is divided by five levels of severity on the left and the five types of B-NICE WMD threats on the top. The reason for organizing the severity levels in descending order, where a Level 5 is the least severe and a Level 1 is the most severe, is to model the matrix after the US Interagency Domestic Terrorism Concept of Operations Plan (CONPLAN). The CONPLAN incorporates the severity levels of a terrorist threat in descending order.

The use of the B-NICE acronym to define the all threats element of the decision matrix complies with the existing acronym characterization used by the Federal government and the first responder community. However, to be more specific for both the emergency actions and the use of filters, some subcategories were needed. The two B-NICE subdivisions are biological and nuclear. The biological category is subdivided into three categories of pathogens that can be used in a biological attack. For the nuclear category, a distinction was made between nuclear bombs and a radiological incident.

Another direction for the use of the decision matrix involves a site-specific classification rather than a national or even a regional classification. It is possible to have different level threat incidents in different areas in an entire city; however, if there are multiple related incidents, a judgment can be made by the presiding authority about whether or not the demand for response resources necessitates an elevation in the incident severity level. For example, if there were multiple Level 5 explosions in a region, the presiding authority could designate all incidents as Level 4 because of the coincidence and demand on resources. An example of this can be found in the historical examples matrix in the explosive category. One such example is the Madrid train bombings, which collectively would be considered a Level 4 event, but individually as Level 5.

**EMERGENCY ACTIONS MATRIX**

Once the terrorist event has been classified and declared, the emergency actions matrix (Table 2) will then be utilized. Here, the emergency response is divided into four basic forms of response: Incident Command, Public Health, Security, and Fire/HAZMAT. These four components of emergency response generally cover the immediate response to the actual terrorist incident.

The role of the incident command component of the emergency actions matrix is to incorporate leadership
of the terrorism response operation. Without a general understanding of the role of the command structure and responsibilities, the leadership structure will segment. This segmentation will result in a broken and ultimately inefficient response group. The inherent benefit of a single command and control group has been echoed in the DHS National Incident Management System. This system was the basis for the incident command element of the emergency action matrix. The 9/11 Commission Report has also emphasized the need for an efficient command and control structure: “Effective decision making in New York was hampered by problems in command and control and in internal communications.” Also, a report conducted by the McKinsey & Company group regarding the Fire Department of New York City response to the 9/11 terrorist attacks revealed a weakness in command, control, and communications. Specifically, individual units that were not directed toward central staging areas did not receive necessary information about entering the towers, and dispatch could not accurately track the whereabouts of each unit. The incident command component provides centralized control. Without clear and continuous direction from an established and accountable command structure, any response operation will be severely handicapped.9

The health element addresses the serious public health issues associated with all of the B-NICE WMD. For example, a biological incident carries quarantine and mass immunization issues, and a chemical incident involves decontamination and mass care of an exposed population. The security piece is commonly known as law enforcement actions. This form of response is identified as security, because it allows for the involvement of military support that could be employed in later stages of an emergency response. The Fire/HAZMAT role is essential in most incidences. Effective response after 9/11 depended largely on the fire-responsive capabilities, which coordinated search and rescue operations among other response needs.10

The purpose of including all four of these response groups into the same matrix is to improve upon the lengthy response plans. As stated earlier, though necessary, a lengthy terrorism response plan will not be well known among the entire emergency response community. Assuming the plan is adopted by a local jurisdiction, each component group of the plan will only know what they need to do. This lack of information could easily result in a case of the left hand not knowing what the right is doing. Instead, the decision matrix provides a quick reference that shows the emergency services where their specific response fits into the master plan and what their colleagues in different areas of response are doing. For example, when the president declares that a Level 3 chemical incident has occurred, it is very easy for the media to outline what is being done immediately to respond to the incident. Public confidence is bolstered when clearly, consistently accurate information is provided.11

Though the actions outlined in the decision matrix are too general to be logistically implemented, they provide a guide for all aspects of appropriate emergency response. Another application of this portion of the matrix is that local jurisdictions could easily identify a single public information officer for each area of response.6,12 This customizability would enable the public and other branches of emergency response a single point of contact for more specific information about actions being undertaken.

PUBLIC PROTECTIVE ACTION MATRIX

The public protective action matrix (Table 3) details the measures that need to be taken by members of the public in response to varying levels of WMD severity. This component of the decision matrix also divides the response into four categories: evacuation, shelter-in-place, community shielding, and decontamination.

The evacuation element is almost inevitable in any B-NICE WMD event. The scope of the evacuation is the primary variable. For example, a Level 5 explosive event will require the evacuation of the population in immediate risk of the resulting fires and unstable structures near the blast. However, a Level 1 radiological incident will require the complete evacuation of a population for many miles away from the source of the exposure.13

Primarily, a shelter-in-place order is issued for
<table>
<thead>
<tr>
<th>Level 3</th>
<th>Biological</th>
<th>Nuclear surface burst</th>
<th>Radiological incident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incident command: Initiate ICS structure and establish a Unified Command POC. Assess communications needs and logistics requirements. Begin planning for long-term recovery needs. Execute necessary coordination with regional mass care resources. Appoint a single public information officer for a single point of contact with media.</td>
<td>Incident command: Initiate ICS structure and establish a Unified Command POC. Assess communications needs and logistics requirements. Begin planning for long-term recovery needs. Evaluate need for regional mass care resources. Appoint a single public information officer for a single point of contact with media.</td>
<td>Incident command: Initiate ICS structure and establish a Unified Command POC. Assess communications needs and logistics requirements. Begin planning for long-term recovery needs. Evaluate need for regional mass care resources. Appoint a single public information officer for a single point of contact with media.</td>
<td>Incident command: Initiate ICS structure and establish a Unified Command POC. Assess communications needs and logistics requirements. Begin planning for long-term recovery needs. Consult with technical specialists for plume projections and necessary public protective actions. Appoint a single public information officer for a single point of contact with media.</td>
</tr>
<tr>
<td>Fire/HAZMAT: Support military actions if necessary and assist in evacuation and containment.</td>
<td>Fire/HAZMAT: Support military actions if necessary and assist in evacuation and containment.</td>
<td>Fire/HAZMAT: Assist in evacuation from contaminated area. Enforce containment perimeter and assist with decontamination of equipment and victims.</td>
<td>Fire/HAZMAT: Assist in evacuation from contaminated area. Enforce containment perimeter and assist with decontamination of equipment and victims.</td>
</tr>
</tbody>
</table>

### Table 2. High-Consequence Event Decision Matrix: Emergency Actions

<table>
<thead>
<tr>
<th>Category A</th>
<th>Category B</th>
<th>Category C</th>
<th>Nuclear surface burst</th>
<th>Radiological incident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological</td>
<td>Nuclear</td>
<td>Radiological</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incident Command</td>
<td>Chemical</td>
<td>Explosive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>----------</td>
<td>-----------</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The use of a shelter-in-place order for a public response to a WMD terrorist attack would largely be used in the event of a chemical incident; however, other applications could be extended to other forms of WMD. For example, in an explosive/incendiary event, areas downwind of a large smoke plume would need to shelter-in-place. The main form of shelter-in-place for a nuclear event would only be in approved fallout shelters, which is different from a chemical shelter-in-place order. The use of shelter-in-place in a biological event is the second reason it is utilized in the protective action matrix. Since, most structures will not offer any protection from an airborne environmental bioagent, the shelter-in-place order carries different uses. Primarily, the two uses for a shelter-in-place order are to help control an evacuation and to help enforce quarantine/isolation situations. Admittedly, there is less likelihood a shelter-in-place order could be used for controlling an evacuation because of public fears of contracting a bioagent, but it could be a viable way of conducting a mass quarantine.

The community shielding element in the protective action matrix is a relatively new concept whose primary purpose is to help control a “shadow evacuation” phenomenon. Community shielding is in many ways a psychosocial version of shelter-in-place. People tend to evacuate when there is no threat to their location. In
this case, specific messaging, information centers, and other psychosocial supportive actions would be taken to try and keep people in a likely shadow evacuation area, off the major evacuation routes, and in their communities. Because the decision matrix most likely will be used in major metropolitan areas, likely targets for a WMD terrorist event, the populations are large enough to warrant the incorporation of community shielding as a part of the public response requirement matrix.21

A final component of the protective action matrix is decontamination. Decontamination is an essential component of the public protective actions for a particulate agent. Examples of agents that require decontamination include all chemical agents, radiation agents, some biological agents, and elements projected by explosion or fire.

There has been a great deal of research conducted regarding the best methods of mass decontamination. The most undeniable result of this research is that any person or group of people must be decontaminated to limit the spread of the agent.22 This is especially true for decontamination of people entering a public shelter or healthcare facility. The specific methods of decontamination will not be outlined, but, generally speaking, the methodology is flush-strip-flush-run.23 This method involves flushing a person with water, then stripping his or her clothes and flushing the skin, and then having the person run out of the area. For the decontamination of mass populations some discussion exists on whether self-decontamination should be exercised for those not needing medical attention. The purpose of this approach is to free up decontamination personnel to accelerate the decontamination process.22

HISTORICAL EXAMPLES MATRIX

Although not shown in this article, the historical examples matrix was added to provide a context for the decision matrix. Providing historical examples that fit into the criterion specified in the decision matrix allows the user to have a practical way of relating a current WMD event to comparable disasters. This way, any level user of the decision matrix can look at a developing terrorist incident and be able to get a practical idea about what needs to be done to manage it based on how it was managed in the past.24

DISCUSSION

The role of the High-Consequence Event Decision Matrix is to provide both a definition and a starting point in WMD response. As detailed earlier, there is a lack of standardization in articulating what degrees of WMD events exist between the best and worst case scenarios. The decision matrix fills that gap. Using widely accepted filters for determining the severity of B-NICE events, the matrix pulls all of the noncontiguous definitions of B-NICE WMD events into a single frame. Two advantages are improved organization of WMD response options and psychosocial benefits.

The first advantage of the matrix is organizational. The decision matrix provides the first responder community with an immediate guide concerning appropriate reactions and division of responsibility to a WMD event. By providing this guide, first responders are not independent entities doing whatever their supervisor deems to be a priority. Instead, the entire response is immediately coordinated, even if the level of the coordination is not directed through communication. If every element of the plan is a working concept of the master plan, each component will be embedded in a pre-existing coordinated plan.25

The second advantage of the decision matrix is psychosocial. The matrix supplies clear, consistent, and accurate information to the public. The lack of this clarity in the past has been the leading cause of both shadow evacuations and noncompliance with government orders for public protective action.26,27 This will guarantee failure for any evacuation effort in a major metropolitan area.

The manner by which the decision matrix provides these benefits to the public is twofold. First, by creating a standardized view of B-NICE WMD events, there is little opportunity for interpretation or media exploitation of the event.28 The standardization reduces the media’s capacity for sensationalizing an event because the president or a state governor, being in positions of authority, will limit the discussion during the emergency period about what exactly is going on. Much like the media’s response to the
### Table 3. High-Consequence Event Decision Matrix: Public Protective Action

<table>
<thead>
<tr>
<th>Biological</th>
<th>Nuclear</th>
<th>Incendiary</th>
<th>Chemical</th>
<th>Explosive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category A</strong></td>
<td><strong>Category B</strong></td>
<td><strong>Category C</strong></td>
<td><strong>Nuclear surface burst</strong></td>
<td><strong>Radiological incident</strong></td>
</tr>
<tr>
<td>Evacuation response: Evacuation orders given for immediate areas surrounding high infection area and areas where growth is anticipated to occur.</td>
<td>Evacuation response: Evacuation orders given for immediate areas surrounding high infection area and areas where growth is anticipated to occur.</td>
<td>Evacuation response: Evacuate contaminated area. Establish decontamination areas at points of exit along perimeter.</td>
<td>Evacuation response: Evacuate areas of immediate or anticipated threat.</td>
<td>Evacuation response: Evacuate areas of immediate or anticipated threat.</td>
</tr>
<tr>
<td><strong>Level 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decontamination: Immediately rinse with water and soap only if endospore agents are suspected.</td>
<td>Decontamination: Immediately rinse with water and soap only if endospore agents are suspected.</td>
<td>Decontamination: Immediately facilitate movement of victims from hot zone and into decontamination zone. Place all inanimate objects in drop-off area for radiation screening. Enter decon area to wash and rinse body.</td>
<td>Decontamination: No decontamination necessary.</td>
<td>Decontamination: Immediately leave continuous exposure to hazard. Execute heavy rinsing of exposed victims to any uncontaminated water source if nerve, blood, blister, or choking agent is suspected. Encourage self-decontamination for those able to reduce personnel strain.</td>
</tr>
<tr>
<td>Shielding response: Shielding order issued for areas outside of evacuated areas.</td>
<td>Shielding response: Shielding order issued for areas outside of evacuated areas.</td>
<td>Shielding response: Initiate shielding for areas outside of irradiated area.</td>
<td>Shielding response: No shielding order necessary.</td>
<td>Shielding response: Shielding orders issued only if necessary in areas outside of affected area.</td>
</tr>
</tbody>
</table>
national terror threat levels, when the DHS orders a change in the threat level, the media and jurisdictional officials do not question the fact that the threat level has changed, only why it has changed.29 By mitigating the media’s ability to exacerbate an already terrifying situation for the public, the public response will be much more constructive than what it would be otherwise.28,30

The second benefit is that the decision matrix contributes constructively to the public’s decision-making process.31 For example, if a Level 2 chemical incident occurs, the protective action matrix will provide a rational explanation for why the government has made an order for their locality.

In summation, the High-Consequence Event Decision Matrix provides the terrorism response effort with a standardized and clear outline for both responders and victims. The decision matrix complements existing terrorism response plans by consolidating the content so that, when time is critical, the master plan can be understood by the entire responsive body. The decision matrix fills a knowledge gap that is unacceptable in terrorism response.32

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REFERENCES


Emergency management theory: Issues, barriers, and recommendations for improvement

David A. McEntire, PhD

INTRODUCTION

A massive transformation is taking place in emergency management (EM). For good or for bad, the September 11, 2001, terrorist attacks on the United States have resulted in a significant reformulation of the purpose and nature of EM. Terrorism has become the priority hazard among those making policy decisions. The establishment of the Department of Homeland Security (DHS) with the incorporation of the Federal Emergency Management Agency (FEMA) amounts to the most sweeping reorganization of government in the past five decades. Emergency managers now receive long overdue (but still incomplete) recognition from the general public, while legislators have increased funding for the profession to historic levels. The field is also being positively—and negatively—affected by recent technological developments such as geographical information systems (GIS) and increased industrialization. In addition, training and educational opportunities are providing a more knowledgeable cadre of professionals to meet the future challenges that will inevitably result from further urbanization and modern infrastructure.

The demands placed on emergency managers have risen, but there are also other stakeholders that contribute to disaster prevention and preparedness. EM still retains vestiges of the past, of course. Nonetheless, it is dramatically different than it was prior to 9/11.

Similar changes are occurring in disaster scholarship and EM research. Our perspective about the causes of disasters has shifted, and we now more fully understand the plethora of variables that contribute to their occurrence. The lessons from sociology and geography remain as important as ever, but other disciplines are making vital contributions to the research literature. Revolutionary paradigms have been proposed, and others have been introduced to help integrate them with perspectives of the past. Although there are many issues and functions that are understudied, the knowledge base in EM is expanding at a dramatic pace. It is interesting to see academic efforts in this area evolve despite the many obstacles yet to overcome.

This article assesses the current status of EM theory and explores whether or not theory should be aspired to among EM scholars. The barriers preventing theoretical development are identified as are the central concepts and paradigms of this emerging discipline. Finally, the author’s views on improving the future understanding of EM are presented.

WHAT IS THEORY?

Promoting ideal conditions

The term “theory” conjures up divergent meanings among scholars. This is probably due to the fact that the word can be interpreted in multiple ways. It may refer to the ideal conditions academics try to promote in the world around them. We see disturbing circumstances, and we desire a better situation—one that is free from the problems and mistakes that confront us. In the EM realm, we note a trend of rising disaster losses and frequently witness uncoordinated and haphazard response and recovery operations. Therefore, our objectives are to reduce the probability and impact of disasters and improve postdisaster functions.

Body of knowledge

Another meaning of theory relates to the entire
body of knowledge available in a given discipline. It is difficult to say if such a system of information exists in EM and what it entails, since the field is relatively new and intersects with so many other disciplines. Regardless, the philosophy, data, and research findings are based on a number of components that help to generate theory. These include definitions, concepts, principles, classifications, typologies, models, and causal relationships.

**Clarification of terms**

One of the major purposes of theory is to clarify terms by providing sound academic definitions. In order to convey information and knowledge in any meaningful way, issues and phenomena must be accurately and adequately defined. As an example, if there were no general consensus on what a “hazard” is, we would not be able to understand disasters nor explain how hazards relate to other terms such as vulnerability. Discussions about the different types of hazards (e.g., natural, technological, civil) would be irrelevant and unproductive. Definitions are required if knowledge is to be generated and if links are to be found among disparate topics and variables.

**Concepts**

Theory is also equated frequently with concepts—the heuristic devices that enable understanding. Concepts create mental images in the minds of those who speak, read, or hear about them. For example, the concept of convergence is of paramount importance in EM. It implies that people and donations flow to the scene of disaster. Alternatively, the notion of convergence may be indicative of new problems created when emergency managers try to harness the skills of volunteers or coordinate the flow of goods and services. Other important concepts in EM are emergence and governmental integration. Without such concepts, it would be extremely challenging to comprehend disaster behavior and foster increased professionalism in the field.

**Principles**

Theory may also involve the principles that promote ethics and standards in a particular field. For example, Kreps has suggested that preparedness prior to a disaster and improvisation in the aftermath are the two foundations of EM. Principles relate to the ideal or preferred conditions promoted by academics as discussed earlier, but they are generally more limited in scope and applicability.

**Classification**

Classifications, or illustrations of comparison, are likewise synonymous with theory. Classifications show the differences among similar types of phenomena. In EM, scholars are interested in accidents, crises, emergencies, disasters, catastrophes, and calamities. However, the impact of these events varies based on the number of deaths that result, the extent of geographic impact, the degree of social disruption, etc. Classifications indicate why one issue has more or less of one variable than another. Conveying the degree or extent of phenomena is a major part of any scientific enterprise.

**Typologies**

Typologies, or organized categorizations, have a close relationship to theory. Typologies are similar to classifications in that they are useful for the purpose of comparison. However, whereas classifications typically deal with similar phenomena, typologies focus on different issues. Perhaps the most renowned typology in EM research emanates from the Disaster Research Center in Newark, Delaware. The DRC Typology compares organizational tasks and structures on different axes and shows the unique features of established, expanding, extending, and emergent groups. This visualization has generated a significant amount of research in disaster sociology. The value of such typologies for theory cannot be overestimated.

**Theoretical models**

Theoretical models are charts that show links between different variables or relationships among groups. Some models show how inputs influence outputs. A good illustration of this is a risk-management diagram, which depicts factors that augment vulnerability as well as policies or actions that may decrease the probability or impact of disaster. Other models
show how individuals or divisions relate to organizations as a whole. The Incident Management System (IMS) is probably the most well-known model for EM practitioners. It shows how unified command may take place among many organizations while also illustrating where individuals fall under planning, operations, logistics, and finance/records.

Causal relationships

One of the most significant theoretical components is an explanation of causal relationships. How do one or many variables interact to produce a certain outcome? In terms of EM, we may state that a disaster (D) will occur when a triggering agent (T) interacts with vulnerability (V). In other words,

$$T + V = D$$

If we apply this equation to real-life situations, we may state that a hazard (trigger) is most likely to produce a disaster when urban planning has been haphazard, when building codes have not been enforced, when warning systems are underdeveloped, when preparedness measures have been neglected, and when a geographic area contains special populations or other at-risk groups.

Causal relationships not only help us identify risks; they also promote policies to remedy these situations. Returning to the example mentioned above, disasters can be reduced by addressing vulnerability (e.g., locating in safer areas, building with disasters in mind, establishing a warning system, developing response and recovery plans, addressing the needs of special populations). This type of theory, known as a paradigm, shows us why a problem is occurring and, more importantly, how it can be corrected.

Is theory desirable?

Is it necessary that each discipline have a widely accepted theory? This may seem like a strange question, since the theoretical components presented above underscore the need for a recognized body of knowledge for academic and professional progress. However, there is much more to this inquiry than meets the eye.

Many disciplines tout a central theoretical theme in their research literature. Such a focus helps clarify the priorities and boundaries of the discipline. For years, comprehensive emergency management (CEM) has organized EM functions into useful, but perhaps oversimplified, disaster phases and has been the traditional theory in the field. However, it is vital to recognize that a single perspective can limit understanding. As an illustration, CEM has trouble capturing the wider political, economic, and cultural ramifications of disasters. Because of this weakness, other perspectives have been proposed. One is the social construction perspective, which opposes a technocratic view of disasters. Also, chaos or systems theories, which incorporate a plethora of causative variables, appear to be gaining recognition in EM as well as in other disciplines. Although a single theory can bring identity to a discipline, others may be needed to allow for alternative explanations of the same phenomena.

There is no single overarching theory currently subscribed to in EM. Then again, it would be difficult to develop a theory that could capture every variable and issue associated with disasters. As discussed above, the presence of a single theory may be beneficial or detrimental depending on the contributions it makes to scholarship or the limitations it places on a discipline.

Barriers to theoretical development

There is obviously a need to develop EM theory, but the task is not an easy one. Major epistemological problems exist that hinder its development. McEntire and Marshall have identified at least 10 significant interrelated concerns, which are discussed in detail below.

What is a disaster?

One of the major problems confronting EM scholars is the inability to define the concept of disaster. Perspectives have ranged from acts of God to physical hazards to disruptive social incidents to socially constructed events. Although the complex physical and social aspects of disasters are difficult to describe succinctly, agreement must be found. As Quarantelli has
so eloquently argued, “Unless we clarify and obtain minimum consensus on the defining features per se, we will continue to talk past one another on the characteristics, conditions, and consequences of disasters.”

What is emergency management?

Just as we are struggling to define our issue of focus, we are also finding it difficult to identify our field of study. The term “emergency management” has at least three significant problems. First, as scholars we are really interested in disasters, not emergencies. Second, the focus on the term “emergency” makes the field reactive and limits its applicability to first responders. Third, EM implies we have total control in our ability to deal with disasters. Hence, EM is both a misnomer and an oxymoron.

What hazards should we focus on?

Scholars have been somewhat guilty of following the fads of the profession. Practitioners and academics initially gave priority to the civil hazard of a nuclear exchange between the United States and the USSR during the Cold War. Later, attention shifted to technological hazards due to Three Mile Island, Bhopal, and Chernobyl and then to natural hazards due to the Loma Prieta earthquake, Hurricane Andrew, the Midwest flooding, and the Northridge earthquake.

Today, academia and policy has come full circle, although the civil hazard of modern terrorism is much more complicated than the nuclear threat of the Cold War era. The major dilemma here is that we are confronted with a choice between more common but less consequential events versus infrequent but higher impact events.

Should we continue to focus on hazards?

Another challenge jeopardizing disaster scholarship concerns an affinity for the concept of hazards. In the past, a great deal of attention was given to the physical nature of disasters (i.e., the hazard itself was synonymous with the risk). There is a growing recognition, however, that “a hazard need not a disaster make.” A hazard will not produce a disaster if no people or property are affected (e.g., if it occurs in the desert or other isolated areas). An additional argument is that it is difficult or impossible to control hazards. However, we do have an ability to determine our degree of vulnerability. In short, it should be emphasized that hazards do not necessarily mean we are vulnerable, but vulnerability always relates to hazards.

There is undoubtedly more discussion about vulnerability now than in the past, but the shift has been incomplete and is slow in being fully accepted. One possible explanation for this is that the concept of vulnerability has often been limited to issues of poverty and political marginalization. There is evidence that the concept of vulnerability captures much more than these variables alone, however.

What variables should be explored in academic research?

A number of issues are common to most disasters. These variables, which are often the subject of disaster case studies, include the dangerous location of buildings, improper construction, inadequate warning systems, and poor communication. It is important to remember, however, that many other variables have a bearing on disasters. Examples include cultural attitudes about development, building code enforcement, political preferences for response rather than mitigation, record keeping, mass fatality management, special populations, and critical incident stress. Ergo, following evident empirical patterns can be advantageous but may also preclude investigation into other important and relevant phenomena.

What actors should be incorporated into academic studies?

EM is predominantly a public-sector profession, and research has often been directed at participants in this arena. Unfortunately, such recognition comes at the expense of acknowledging that public officials increasingly rely on private businesses and nonprofit agencies to prevent and deal with disasters. EM research will be incomplete if the blurring of sector boundaries and functions is not taken into account.
What disaster phase should be given priority?

EM has traditionally been a reactive profession, neglecting mitigation and recovery and spending much of its time addressing preparedness measures for emergency response. The problem with such an approach is that it does very little to address rising disaster losses. Consequently, there is a strong and ongoing movement to promote the reduction of risk before and after disaster strikes. No one can doubt the need to incorporate a more proactive approach to disasters. Disaster trends suggest we are repeating mistakes that have to be corrected now and avoided in the future. Although it is impossible to eliminate all risk, scholars must find ways to incorporate each phase into discussions of EM theory without relying solely on the reactive approach of yesteryear.

What disciplines should contribute to emergency management?

EM scholarship owes its existence to two fields of study: geography and sociology. Geography enabled us to understand the physical characteristics of hazards, while sociology fostered an understanding of social causes and human behavior in disasters. As important as these two disciplines have been and are to EM, they do not encompass all types of disaster phenomena. Knowledge of engineering, cultural attitudes, political values, emergency medical care, public health, psychological distress, economic impact, and modern technology also come into play. Obviously, EM theory must not forget its roots in the founding disciplines, but theoretical progress will be stifled if contributions from other fields are not taken into account.

What paradigms should guide the field?

Right now, an impressive degree of competition exists among distinct theoretical perspectives in EM. As previously mentioned, CEM was the first concept to unify and give direction to the field. Nonetheless, it has been recognized that the preparedness and response focus of CEM is somewhat limiting and a wider policy framework is needed. Geis and Armstrong have suggested a move toward a “disaster resistant community,” while Britton and Clarke, Burby et al., and Buckle et al. have recommended focusing on resilience as a guiding principle. In contrast, other researchers such as Boullé et al., Berke et al., and Mileti propose the incorporation of sustainability and sustainable hazards mitigation.

Although these perspectives address some of the problems associated with CEM, they are not free of drawbacks. For instance, Mileti believes that disaster resistance is a constraining theory compared with other alternatives. Resistance has a strong inclination toward engineering and the physical sciences, but it seems to imply that disasters may be virtually eliminated, and it relates very little to preparedness, response, and recovery. Resilience is used in different ways by various scholars, but it generally implies a reactive stance toward disasters. Geis asks, if resilience is defined as the ability to recover from or adjust easily to misfortune or change, do we want our communities to “recover,” or do we want to prevent events from reaching disastrous proportions? There are similar problems with sustainability and sustainable hazards mitigation. These concepts stress the importance of environmental protection but do not deal with the current threat of terrorism. Sustainable hazards mitigation also may not give enough attention to vulnerability (which is ironic considering that most of today’s scholars are calling for social construction perspectives). Furthermore, sustainable development inadvertently suggests omnipotence over hazards. Berke comments that sustainable development has little relation to emergency preparedness and response issues (e.g., disaster warning, search and rescue, evacuation, and sheltering). Perhaps it is for these reasons that Aguirre has questioned whether sustainability can actually sustain us.

The focus on risk and homeland security makes similar errors and omissions. Wisner et al. caution us about accepting the traditional view of risk: “Too much emphasis in doing something about disasters is put on the . . . hazards themselves.” Homeland security is a step back from the proactive approaches being recommended today, and it de-emphasizes all hazards other than terrorism. As Waugh points out, “even within the Homeland Security apparatus, minimal attention is being paid to matters beyond prevention of terrorism-related disasters.” This rivalry among divergent and incomplete theories has created
confusion for a discipline that desperately needs an encompassing vision and direction.

What is the proper balance of knowledge?

A final problem in EM scholarship deals with the best source of information for the discipline. Scholars stress the value of theory and research over practical experience and knowledge yet often consult with professionals in the field. Conversely, EM professionals stress the benefit of real-world practice yet want the profession to advance in upcoming years. Both perspectives have merit and drawbacks. A balance must be sought between the two if EM theory is to be relevant to both academics and practitioners in the future.

RECOMMENDATIONS FOR IMPROVING EMERGENCY MANAGEMENT THEORY

As we try to advance EM theory, it might be wise to recall a statement made by Claire Rubin in a paper for the Natural Hazards Research and Applications Information Center at the University of Colorado/Boulder: “We must save the foundation but modernize the house.” Theoretical frameworks of the past should not be discarded but should be adapted and enhanced to meet future demands. The following are some recommendations for developing effective EM theory. Although not a comprehensive list, these suggestions may provide a useful starting point for this emerging discipline.

First, scholars interested in promoting EM theory should, as Rubin suggested, retain the findings from prior research. These would include concepts such as disaster, hazard, convergence, and emergence. New concepts, such as compound disasters and sustainability, should be incorporated to illustrate the complexity of modern disasters and the need for environmental protection. EM theory should also incorporate the principles of disaster prevention, preparedness, and improvisation. The needs of special populations should be taken into consideration, and political and economic marginalization should be explored.

The differences between accidents, disasters, and catastrophes should be delineated through the classification process, while the Disaster Research Center typology on different disaster organizations should be emphasized in the research literature. Models such as the IMS should be discussed and compared with alternative viewpoints. Other models of decision making (e.g., rational, bureaucratic, incremental, group think, perception/misperception) should also be absorbed into EM theory to explain organizational dynamics and policy making. These theoretical constructs will help both students and scholars understand the nature of disasters and appreciate the difficulty of successful EM operations.

An additional recommendation for EM theory is to continue to search for an accepted definition of disasters. My own definition is as follows:

Disasters are the disruptive and/or deadly and destructive result of physical or human-induced triggering agents when they interact with, and are exacerbated by, vulnerabilities from diverse overlapping environments.

Although this definition may not be acceptable to everyone and the debate may never be fully resolved, continual effort must be made to understand the physical, social, and cascading aspects of disasters. Quarantelli has edited an outstanding book on the subject, which should be a standard in any course on disasters and EM theory. Professors should also strive to teach both conservative and radical interpretations of disasters in their EM classes.

Another way to foster theory is to seek an alternative name for the field. There are many possibilities being discussed including disaster management, risk management, sustainable hazards management, or disaster vulnerability management. While it is doubtful the term “emergency management” will disappear due to its increased recognition in recent years, scholars should at least make explicit the drawbacks of continuing to apply this name to the discipline.

Strong EM theory must also acknowledge all types of hazards, whether natural, technological, or civil. In the United States, downplaying one hazard or giving preference to others is tantamount to saying
we only face certain types of risks. History, however, teaches us that we are affected by various events including floods, earthquakes, tornadoes, power outages, computer failures, chemical spills, riots, terrorism, and even space shuttle disasters. Of course, EM theory should convey the dilemma surrounding probability versus consequences, and disaster research should reflect different needs at the local or state level. What is more, we should accept the fact that we cannot truly control hazards; we can only limit our degree of vulnerability. We must acknowledge all types of hazards and downplay the feasibility of controlling them if EM theory is to improve.

Another proposal for improving EM theory is to establish a multicausal view of disasters. Due to the large numbers of variables to be studied, it might be wise to incorporate chaos and systems theories to guide research and maintain a broad understanding of the complexities of disaster phenomena. As Geis notes, everything is interconnected, and as such a holistic, integrated approach will prove the most effective. Comprehensive perspectives should be more valued in future disaster scholarship.

EM theory must also embrace the different actors involved in EM, regardless of whether they are from the public, private, or nonprofit sector. Local emergency managers may continue to get the balance of attention in future research, but we must not disregard the assistance of state and federal officials, diverse government agencies, businesses, humanitarian organizations, and citizen volunteers. The concept of integration (both horizontal and vertical) may assist us as we try to improve networking, collaboration, communication, and coordination among these groups.

Maintaining a foundation based on the phases of disasters should likewise be a priority in EM theory. Neal has indicated convincingly that the four phases remain a valuable if oversimplified heuristic device. Mitigation, preparedness, response, and recovery have played a significant role in establishing the field and categorizing distinct EM functions. While more research should be directed toward mitigation and recovery, preparedness and response are no less relevant. It is also important to integrate research from all contributing disciplines. Students must appreciate the diversity of issues and functions that come into play in EM. These include but are not limited to hazard and vulnerability analysis, land-use planning, engineering, training, exercising, community education, grant acquisition, budgeting, warning, evacuation, sheltering, fire suppression, emergency medical care and triage, search and rescue, mass fatality management, media relations, disaster declaration, donations management, debris management, and critical incident stress management. We must also include the sociological aspects of disaster and the findings about human behavior, which helped to establish the discipline in the first place.

Above all, the political barriers facing the field and creative ways to overcome them (e.g., persuasive arguing and political maneuvering) should be incorporated into EM theory. If values and politics are producing most of our disaster problems, it is essential that these be the central issues of future research. Thus, the whole purpose of combining findings from different disciplines is to reveal the “big picture” of disasters and EM.

**HOW CAN THESE CHALLENGES BE ADDRESSED?**

Thus far, this article has addressed some of the problems facing EM theory development and has listed some of the topics that should be included in future research. But this does not necessarily indicate how these difficulties might be overcome. The following recommendations may help remove barriers to the development of a comprehensive theoretical framework for EM.

First, scholars must think critically about theoretical concepts and paradigms. It is imperative that we become cognizant of values as they relate to the paradigms being proposed today. We must walk the very fine line between pushing for a more proactive approach while recognizing the limits of what we can do to prevent disasters. We cannot sit back and watch the rise in disaster losses and fail to propose new ideas to deal with them. At the same time, we must take into consideration the inevitability of trade-offs for the public good and be ready to tackle events that require response and recovery operations. Effective
theory must accept both our ability and futility in dealing with disasters.

Along these same lines, scholars must ensure that our perspectives are realistic so that policy guidelines will be achievable. If our theory is based on faulty assumptions, the conclusions will inevitably be problematic. On the other hand, if our premises are grounded in reality, we are more likely to generate theories that will have practical application. Thus, another goal of theory should be to understand the barriers to change and how things can be different so that the means to progress can be more easily identified and implemented.

**Incorporating the concept of vulnerability in emergency management theory**

A third and final proposal to improve EM theory is to consider the utility of the concept of vulnerability. Vulnerability, unlike hazards, is the only thing we really have control over in the disaster equation. Thus, vulnerability may help us better comprehend the true nature of disasters. Vulnerability highlights the purpose of EM, since it deals with the goals of liability reduction and capability enhancement (i.e., reducing risk and susceptibility and raising resistance and resilience). In this sense, our efforts to manage vulnerability are based on, but broader than, the IMS, which assessed risks, determined capabilities, and attempted to close the gap between them. Vulnerability also is relevant to all types of disasters—natural, technological, and civil.

Vulnerability is related to the variables influencing disasters and the players in and phases of EM. For instance, our physical location and infrastructure may make us vulnerable to disasters. Our culture, economic conditions, political system, and weak EM institutions can bring disaster upon us and constrain our ability to react to them. Government agencies, businesses, and citizens can augment our degree of vulnerability, while everyone in the public, private, and nonprofit sectors may have a role in reducing it. Activities during the mitigation and recovery phases of disaster obviously increase or decrease vulnerability (e.g., locating or rebuilding in less hazardous areas). But, as the events of 9/11 have shown, even preparedness and response functions (e.g., the failure to acquire compatible communications equipment, the lack of joint planning and training operations, failure to heed warnings, and incomplete evacuations) can determine our degree of vulnerability to hazards. What is more, vulnerability has an extremely close relation to most of the disciplines that contribute to EM scholarship (Table 1).

Thus, vulnerability is apt to unify the field by synthesizing findings from numerous disciplines—perhaps more so than any other concept currently in the field.

Vulnerability also captures and integrates findings from the paradigms proposed in the past and those recommended today. It acknowledges that we must take a holistic approach to disasters (as was the intent of CEM). It also incorporates the need to protect the environment and to develop in a safe manner (i.e., sustainability). Furthermore, it encompasses resistance (e.g., safer engineering) and resilience (e.g., the ability of social, political, economic, and cultural systems to rebound after a disaster). Risk and vulnerability are often used interchangeably in the research literature. The concept also shapes homeland security policy, especially as it relates to epidemiology and bioterrorism.

Interestingly, a recent survey of the literature adds support for the model of vulnerability proposed by McEntire. Weichselgartner reviewed several definitions of vulnerability, and some interesting parallels to McEntire’s model have become evident. Liverman, Dow, Smith, Cutter, Bohle et al., and Dow and Downing have reported on the physical and social dimensions of vulnerability along with the many associated variables that influence it. Other researchers have discussed the way values, actions, inaction, circumstances, poverty, choices, land use, exposure, etc. (i.e., liabilities) contribute to vulnerability. Vulnerability has frequently been tied to capacity or capabilities in the literature and its relationship to risk and susceptibility has been discussed. Other research has identified a link between vulnerability and the concepts of resistance and resilience. Hence, there is significant justification for viewing vulnerability...
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<th>Discipline</th>
<th>Views of vulnerability</th>
<th>Recommendations</th>
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<tbody>
<tr>
<td>Geography</td>
<td>Vulnerability is determined by the use of hazard-prone areas.</td>
<td>Land-use planning that takes into account hazards to reduce risk.</td>
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<tr>
<td>Meteorology</td>
<td>Vulnerability is due to a lack of advanced warning of severe weather.</td>
<td>Acquisition, creation, and effective use of warning systems.</td>
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<tr>
<td>Engineering</td>
<td>Vulnerability occurs when structures and infrastructures cannot withstand the forces of hazards.</td>
<td>Design and construct buildings and infrastructure that promote disaster resistance.</td>
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<tr>
<td>Anthropology</td>
<td>Vulnerability emanates from constraining values, attitudes, and practices.</td>
<td>Alter attitudes to discourage risk-taking practices and susceptibility.</td>
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<tr>
<td>Economics</td>
<td>Vulnerability is related to poverty and results in an inability to prevent, prepare for, or recover from a disaster.</td>
<td>Improve the distribution of wealth and purchase insurance to minimize losses and promote resilience.</td>
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<tr>
<td>Sociology</td>
<td>Vulnerability is a product of inaccurate assumptions about disaster behavior and is related to race, gender, age, disability, etc.</td>
<td>Understand behavioral patterns in disasters, and pay attention to the needs of special populations.</td>
</tr>
<tr>
<td>Psychology</td>
<td>Vulnerability is a function of overlooking or minimizing risk and not being able to cope emotionally with stress and/or loss.</td>
<td>Help people to recognize risk and provide crisis counseling to foster resilience.</td>
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<tr>
<td>Epidemiology</td>
<td>Vulnerability is susceptibility to disease or injury and is related to malnutrition and other health factors.</td>
<td>Improve provision of public health/emergency medical care before, during, and after disasters.</td>
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<tr>
<td>Environmental science</td>
<td>Vulnerability is proneness to environmental degradation, which may change weather patterns and produce long-term disasters.</td>
<td>Conserve natural resources, protect green-space areas, and ensure that debris management is performed in an environmentally conscious manner.</td>
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<td>Political science</td>
<td>Vulnerability is produced by the political structure and incorrect decision making.</td>
<td>Alter structure of political system and educate politicians and legislators about disasters.</td>
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<td>Public administration</td>
<td>Vulnerability results from misguided laws, the failure to implement policies effectively, and the inability to enforce regulations.</td>
<td>Strengthen response and recovery capabilities through preparedness measures, improved policy implementation, and increased code enforcement.</td>
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<tr>
<td>Law</td>
<td>Vulnerability is susceptibility to liability after disaster due to negligence (a failure to act as reason or the law dictates).</td>
<td>Understand the law, and ensure compliance to widely accepted ethical practices in EM.</td>
</tr>
<tr>
<td>Journalism</td>
<td>Vulnerability is a result of insufficient public awareness about hazards and how to respond to disasters.</td>
<td>Dispel myths about disasters, foster increased media capabilities, and educate the public about hazards.</td>
</tr>
<tr>
<td>Emergency management</td>
<td>Vulnerability is the lack of capacity to perform important functions before and after disaster strikes (evacuation, search and rescue, public information, etc.).</td>
<td>Foster public awareness about disasters and build capacities through hazard and vulnerability analyses, resource acquisition, planning, training, and exercises.</td>
</tr>
<tr>
<td>Homeland security</td>
<td>Vulnerability is due to cultural misunderstandings, permeable borders, fragile infrastructure, and weak disaster-management institutions.</td>
<td>Correct domestic and foreign-policy mistakes, enhance counterterrorism measures, protect borders and infrastructure, and improve WMD response capabilities.</td>
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as a major component of EM theory, and it should be a central feature in the future.

CONCLUSION

Just as the profession of EM is undergoing a massive transformation, so too is scholarship in this area. Never before has there been such a pressing need to advance our knowledge in this field. This article has attempted to explain the meaning of theory in the EM context and to illustrate why it may be both beneficial and detrimental for academia. It has also addressed the barriers to the development of effective EM theory and offered suggestions for improving theoretical development in the future. Although these views may not be accepted by other disaster scholars, it is hoped this article might at least encourage others to help shape the direction of this vital discipline.

ACKNOWLEDGMENT

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