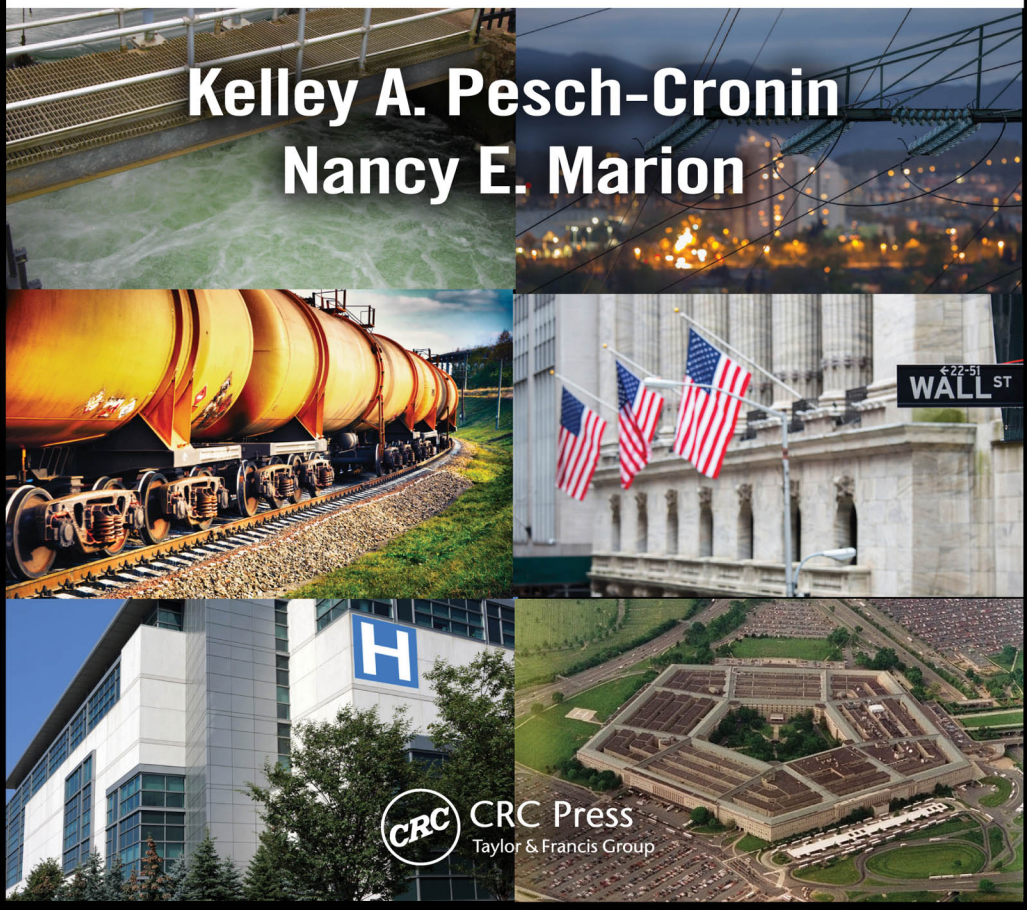
Critical Infrastructure Protection, Risk Management, and Resilience

A POLICY PERSPECTIVE

Kelley A. Pesch-Cronin
Nancy E. Marion



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KP: For Michael, thank you for your amazing support and encouragement. And for my children, may you find peace and happiness always.

NM: For Bobby and Moonbeam. Go Bubblepop! It's huge-big!!

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Dr. Kelley A. Pesch-Cronin is an associate professor at Notre Dame College of Ohio, South Euclid, Ohio. Her research interests include homeland security and emergency management issues, especially as they pertain to policy and politics. Previously, she worked in municipal government and local law enforcement and has coauthored several books in this field.

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Critical Infrastructure and Risk Assessment

INTRODUCTION

In August 2005, Hurricane Katrina struck New Orleans, Louisiana. As a Category 3 hurricane, there were sustained winds of 125 miles/hour and massive flooding. Hundreds of residents were displaced from their homes and had no food, water, shelter, or medical assistance. Much of the city was devastated. Businesses were in shambles.

Many residents of the city believed that the federal government did not respond quickly to meet the needs of the communities and businesses from the damaged areas. Many victims sought relief from the government but found none. The federal agency responsible for providing assistance after a national disaster, the Federal Emergency Management Agency (FEMA), was accused of failing to provide help for days after the event. Even then, it seemed that FEMA officials were unprepared to deliver aid and that many government officials, including President George W. Bush, were not aware of the seriousness of the hurricane and the ensuing damages. The lack of attention resulted in an escalation of destruction and multiple deaths.[1]

A few years later, in 2008, another hurricane, Ike, slammed into the Gulf states of Texas, Florida, Louisiana, and Mississippi, again causing widespread damage with multiple injuries and deaths. Afterward, state leaders again accused FEMA of failing to provide needed assistance to residents of those states in a timely manner.[2]

The same complaints were heard from residents of New York, New Jersey, and Connecticut after Hurricane Sandy hit the East Coast of the US in 2012, killing more than 100 people. The heavy rains, powerful wind, and storm surges caused massive flooding in major cities. Water surged through the nation's Financial Center and New York's public transportation system. Major power outages affected almost 8 million businesses and homes in 15 states.[3] Major airports, schools, and government offices were closed. Gas shortages only served to complicate the circumstance. Residents were in need of basic necessities of shelter, food, and water and more than 352,000 people registered for assistance from the federal government.[4] While many praised the government's response to Sandy,[5] others made it clear that FEMA's response was delayed and they failed to efficiently provide basic services to those affected by the storm, again escalating the storm's effects.[6]

Catastrophes like these and other devastating events can cause a disruption of vital government services that people rely on each day. Disasters can be caused by either a natural event (a hurricane, earthquake, or flood) or a human act (i.e., a terrorist attack). Either way, residents affected by a calamity often do not have the critical services they need to survive in the days after an event. Government agencies and businesses may be unable to provide basic services needed for a community to maintain itself. Citizens may find themselves without access to water, food, shelter, or power sources. If serious enough, the disruption can pose a serious risk to society: there is a risk that even more citizens will be harmed or killed or additional property will be damaged as looting occurs in the time before services are restored.

Natural events such as Katrina, Ike, and Sandy, and man-made events such as the terrorist attacks of September 11, 2001 or the subsequent anthrax attacks on media outlets and members of Congress demonstrate how vulnerable assets and systems can be. If they are damaged or incapacitated, even for a short time, there can be a debilitating effect on the nation's security, economic system, or public health (see Note 3). People may be prevented from traveling from one place to another easily, and needed goods and products may not be accessible. There may not be effective and reliable communication systems, financial services, power, food, or medical services. Officials across the country may find it difficult to monitor, deter, and if necessary, respond to possible hostile acts. If these disruptions become prolonged, it could have a major impact on the country's health and welfare.

The damages caused by recent events in the US, both natural and man-made, have made it clear that there is a need to reexamine how the

country protects its assets and seeks to ensure that critical services are available to citizens in the days and weeks following an event. Both victims and nonvictims have called on government officials to enact policies that will protect the nation's critical infrastructure so they are better able to withstand events, or if damaged, can recover quickly. These disasters made public officials realize that the government needed to put more emphasis on the security of the nation's infrastructure during a disaster or terrorist act, to ensure that basic services are available to citizens. It has become unmistakable that protecting the nation's critical infrastructure is essential to public health and safety of residents, the economic strength, the way of life, and national security.[7] Thus, one of the goals for government officials in the recent years was to ensure the protection of the country's critical infrastructure. This way, the country will be safer, more secure, and even more resilient in the aftermath of an event.

Today, the Department of Homeland Security (DHS) spends billions of dollars annually to prevent (or mitigate), prepare for, respond to, and recover from an incident, whether it be natural or man-made. The government's goal has become national preparedness, which they define as: "The actions taken to plan, organize, equip, train, and exercise to build and sustain the capabilities necessary to prevent, protect against, mitigate the effects of, respond to, and recover from those threats that pose the greatest risk to the security of the Nation."[8] In order to fulfill the *National Preparedness Goal*, the focus of DHS shifted from focusing primarily on terrorism threats to all-hazards threats. This shift has been significant and continues to be debated as to how best to balance the approach to prevention, response, and recovery.

It is critical that government officials and private individuals alike understand government attempts to identify and protect the country's critical infrastructure as they seek to ensure that essential services and goods are available to residents in the aftermath of a disruptive event such as a hurricane, earthquake or flood, or a terrorist attack. The proper identification of structures deemed to be critical infrastructure and the strategies to protect them has become a priority in today's world. Although essential, these steps have also become controversial. It is important to begin our analysis of critical infrastructure protection by defining essential terms that are used frequently by those who seek to protect the nation's critical infrastructure. Over time, the meanings of some terms have changed and become muddled. In some cases, the meanings of some terms vary regionally across the country. For that reason, it is important to define the terminology that will be used throughout the remainder of the book.

WHAT IS CRITICAL INFRASTRUCTURE?

The term "critical infrastructure" has changed over time and because of that, the term is sometimes ambiguous or blurred. Prior to the September 11, 2001, terrorist attacks in the US, the term "infrastructure" referred primarily to public works (facilities that were publicly owned and operated) such as roadways, bridges, water and sewer, airports, seaports, and public buildings. The main concern at that time was how functional these services were for the public. This began to change during the early 1990s after the nation witnessed major disasters such as the bombings of the World Trade Center (1993) and the Oklahoma City building (1995). About this time, the threat of terrorism was also emerging in the US and consequently, the definition of what is meant by critical infrastructure has become much broader.

Now the term critical infrastructure is a general term that refers to the framework of man-made networks and systems that provide needed goods and services to the public. In other words, it is the facilities and structures, both physical and organizational, that provide essential services to the residents of a community, which ensure its continued operation. This term includes things such as buildings, roads and transportation systems, telecommunications systems, water systems, energy systems, emergency services, banking and finance institutions, and power supplies. In addition to physical structures and assets, the term incorporates virtual (cyber) systems and people.

In general, critical infrastructure is all of the systems, which are indispensable for the smooth functioning of government at all levels. It is the asset that is vitally important or even essential to a community or to the nation that, if disrupted, harmed, or destroyed, or in some way unable to function, could have a debilitating impact on the security, economics, or national health, safety, or welfare of citizens and businesses.[9] There could also be a significant loss of life if these services are not provided.

Critical infrastructure can be divided into Tier 1 and Tier 2 facilities. Tier 1 facilities and systems are those structures that, if attacked or destroyed by a terrorist attack or natural disaster, would cause significant impacts on either the national or regional level. These would be impacts similar to those that occurred in Louisiana after Hurricane Katrina or resulting from the terrorist attacks of September 11, 2001. Tier 2 facilities and systems are less critical but still needed for a strong community (see Note 7, p. A-6). The distinction between a Tier 1 and a Tier 2 asset is used by officials as they make better decisions about how to allocate resources

for critical infrastructure protection. The categories are reviewed annually and are changed as needed. The Tier 1/Tier 2 list is classified and not available to the public (see Note 7, pp. 1–14).

A similar term is key resources. As defined in the Homeland Security Act of 2002 and the 2003 National Strategy, key resources are the assets that are either publicly or privately controlled and are essential to the minimal operations of the economy and government. These documents identified five key resources: (a) national monuments and icons, (b) nuclear power plants, (c) dams, (d) government facilities, and (e) commercial key assets. By 2009, the number of sectors and key resources expanded to 18 and were called critical infrastructure and key resources. Since then, the concept of critical infrastructure and key resources (CIKR) has evolved to encompass the sectors and resources. For the most part, key resources are not separated from critical infrastructure in today's nomenclature, and the terms are used interchangeably.

Local Critical Infrastructure

Each community has assets that provide a service to its residents and need to be protected from both natural and man-made events. What assets are defined or labeled as critical infrastructure can be different in different cities or regions of the country—critical infrastructure assets are different in Cleveland as compared with Los Angeles, or even Tampa or Denver, because they have different weather conditions, different needs, and different assets. In considering a community's critical infrastructure, it is essential to know how valuable an asset is to that community and whether, or to what extent, it needs to be protected. Community leaders must rank assets by placing some kind of a value on them. In some cases, a community's critical infrastructure can be one major structure that is very costly to build, maintain, and operate, like a water purification plant. Clearly, a community relies heavily on this service, but because of the enormous cost, a community can only afford one of them. Protecting this structure would be vital to the community. This asset provides a needed service to residents, and there would be serious impacts on the health of the community should this plant be harmed in some way. Officials need to know if an asset is vulnerable to a natural disaster, or if it would be an attractive target for an attack. It is also important to know if there is a back-up or secondary method for providing the service to residents.

Federal Critical Infrastructure

On the federal level, there are thousands of assets that are considered to be critical infrastructure. The Homeland Security Act of 2002 and the Homeland Security Presidential Directive-7 (HSPD-7, 2003) require officials in DHS to identify the nation's critical assets and networks (the national infrastructure). This list is found in a document called the National Asset Database, maintained by the Office of Infrastructure Protection (OIP). There are 77,000 national assets on the list that are located across the country, with about 5% of those assets (only 1,700) labeled as critical.[10] This would include assets such as power plants, dams, or hazardous materials sites.[11] The critical infrastructure assets in the US include a power grid that is essential for daily life that is interconnected with other national systems. There are 4 million miles of paved roadways with 600,000 bridges. There is also a complex rail system in the US that includes 500 freight railroads and 300,000 miles of rail track. There are 500 commercial service airports along with 14,000 general aviation airports. In addition, there are 2 million miles of oil and gas transmission pipelines; 2,800 electric plants; 80,000 dams, 1,000 harbor channels, and 25,000 miles of inland, intracoastal, and coastal waterways servicing more than 300 ports and 3,700 terminals. Clearly, if any of these facilities were to be attacked and damaged, communities and residents may be seriously impacted.[12]

The list of critical assets is sometimes controversial, as officials in the federal, state, and local governments, and the private sector owners, often disagree about what should be included in the directory. For example, the list includes many assets that are considered to be local assets, such as festivals and zoos, which some officials argue should not be included. However, DHS includes all assets in an attempt to create a comprehensive inventory of critical infrastructure around the country. Thus, identifying a comprehensive list of national critical assets continues to be an ongoing debate for the DHS.[13] The number of assets in each sector is found in Table 1.1.

Private Critical Infrastructure

In addition to having local assets and federal assets, there are also privately owned critical infrastructure assets. Most people have the perception that critical infrastructure is owned and operated by the government, but in reality 80% of the critical infrastructure in the US is owned and operated by the private sector.

Table 1.1 Numbers of Critical Assets by Sector

Government facilities	12,019
Emergency services	2,420
Nuclear power plants	178
Chemical/hazardous materials	2,963
Telecommunications	3,020
Water	3,842
Banking and finance	669
Transportation	6,141
Information technology	757
Agriculture and food	7,542
Dams	2,029
Energy	7,889
Postal and shipping	417
Public health	8,402
National monuments and icons	224
Commercial assets	17,327
Defense industrial base	140
Not specified	290

Source: Moteff, J. 2007. *Critical Infrastructure: The Critical Asset Database*. Washington, DC: Congressional Research Service, RL 33648. Retrieved from: http://fas.org/sgp/crs/homesec/RL33648.pdf. Office of the Inspector General. Department of Homeland Security. Progress in Developing the National Asset Database.

Because many assets are owned by private entities, the private sector must be involved in planning for protecting those valuable assets. Many documents, including the National Strategy, the Homeland Security Act, and HSPD-7, address the importance of including all partners in coordinating protection efforts. These documents make it clear that protecting the infrastructure cannot be accomplished effectively simply by the government and the public sectors. Instead, they must work jointly with private sector owners and operators. The government can assist owners and operators of critical infrastructure in many ways, such as providing timely and accurate information on possible threats; including owners in the development of initiatives and policies for protecting assets; helping corporate leaders develop and implement security measures; and/or

helping to provide incentives for companies whose officials opt to adopt sound security practices (see Note 7, pp. 1–15).

CRITICAL INFRASTRUCTURE INFORMATION

In addition to critical infrastructure assets, there is also something called critical infrastructure information (CII). This is the data or information that pertains to an asset or critical infrastructure, and is considered to be sensitive but not always classified (secret). An example of CII is knowledge about the daily operations of an asset, or a description of the asset's vulnerabilities and protection plans. CII can also include information generated by the asset such as patient health records or a person's banking and financial records. CII could also be any evidence of future development plans related to the asset, or information that describes pertinent geological or meteorological information about the location of an asset that may point out potential vulnerabilities of that facility (e.g., a dam at an earthquake-prone site). In general, CII refers to any information that could be used by a perpetrator to destroy or otherwise harm the asset or its ability to function.

The importance of protecting CII was first identified in the CII Act of 2002, passed by Congress. It was noted that when a private organization chose to share information with government officials, that information then became a public record and could be accessed by the public through public disclosure laws. Many companies did not want to make that information public, so they were reluctant to work with government agencies and officials. As a way to protect that information and encourage more cooperation, the Congress created a new category of information they called CII. According to the law, any federal official who knowingly discloses any CII to an unauthorized person may face criminal charges. They could be removed from their position, may face a term of imprisonment of up to 1 year as well as fines. The information may be disclosed to other state or local officials, if it is used only for protection of critical infrastructures. The law was passed to ensure that only trained and authorized individuals who need to know the information can access it and use it only for homeland security purposes.

CRITICAL INFRASTRUCTURE PROTECTION

To protect the critical infrastructure and CII, and in order to maintain services if an event occurs, it is essential that officials from the federal, state, and local governments, as well as private owners of the nation's critical

infrastructure, develop plans not only to protect their assets from possible harm, but also action plans to respond to an attack or other harm. These plans must be reviewed regularly and updated as potential threats continue to change. The term "critical infrastructure protection" (CIP) refers to those actions that are geared toward protecting critical infrastructures against physical attacks or hazards. These actions may also be directed toward deterring attacks (or mitigating the effects of attacks) that are either man-made or natural. While CIP includes some preventative measures, it usually refers to actions that are more reactive in scope. Today, CIP focuses on an all-hazards approach.

The primary responsibility for protecting critical infrastructure, and for responding if it is harmed, lies with the owners and operators, but the federal government and owners/operators work together to identify critical infrastructure, and then to assess the level of risk associated with that asset. The assets' potential vulnerabilities are determined, and possible methods for reducing the risk are identified. If owners and operators are unwilling or unable to participate in this process, the federal government can intervene and assess the protection level and devise a response.[14] While most critical infrastructure protection is carried out at federal, state, and local level, there is also a global perspective to protecting critical infrastructure as the world becomes more global.

A related term is critical infrastructure assurance (CIA). This revolves around the process by which arrangements are made in the event of an attack or if an asset is disrupted, to shift services either within one network, or among multiple networks, so that demand is met. In other words, it has to do with detecting any disruptions, and then shifting responsibilities so that services can continue to be met. This can often be done without the consumer's knowledge.

RISK

The probability that an asset will be the object of an attack or another adverse outcome is its risk.[15] Risk is the likelihood that an adverse event will occur,[16] and is related to consequences (C), vulnerabilities (V), and threats (T), as described in the following formula. The National Infrastructure Protection Plan (NIPP) expresses this relationship as follows:

Risk = (function of) (CVT)

It is essential that CIKR owners and operators assess the potential risk to their assets using these three elements. This way, they can make policies to protect the critical infrastructure and plans to respond if that were to occur. Each element is described in the following.

Consequence

A consequence is the effect or result of an event, incident, or occurrence. This may include the number of deaths, injuries, and other human health impacts; property loss or damage; and/or interruptions to necessary services. The economic impacts of an event are also critical consequences, as many events have both short- and long-term economic consequences to communities or even to the nation.[17] It is important that there is business continuity, which is the ability of an organization to continue to function before, during, and after a disaster (see Note 7, p. A-2).

Vulnerability

A vulnerability is "a physical feature or operational attribute that renders an entity open to exploitation or susceptible to a given hazard" (see Note 17, p. 33). It is easy to think of it as a weakness or flaw in an asset that may cause it to be a target for an attack. An aggressor may seek out a vulnerability and use that to strike the asset. In most cases, the major vulnerability is access control whereby unauthorized people can enter the asset (such as a building or open area) to gather information to plan an attack, or even to carry out an attack. To reduce this possibility, it has become common practice to prohibit unauthorized people from entering these types of areas (see Note 17, p. 33).

Structural vulnerabilities need to be addressed and maintained over an extended time rather than relying on a temporary solution or a "quick fix." This extended approach is referred to as long-term vulnerability reduction. The *National Preparedness Goal* defines the long-term vulnerability reduction core capability as to "build and sustain resilient systems, communities, and CIKR lifelines so as to reduce their vulnerability to natural, technological, and human-caused incidents by lessening the likelihood, severity, and duration of the adverse consequences related to these incidents" (see Note 8, p. 11). According to the DHS, the initial national capability target is to "achieve a measurable decrease in the long-term vulnerability of the Nation against current baselines amid a growing population based and expanding infrastructure base" (see Note 8, p. 11).

Threat

A threat is a "natural or man-made occurrence, individual, entity, or action that has or indicates the potential to harm life, information, operations, the environment, and/or property." This term has also been more simply defined as "an intent to hurt us."[18] Threat has to do with potential harm that can originate from any source, including humans (terrorists or active shooter); natural hazards (different threats for different parts of the country); or technology (a cyberattack). Those charged with protecting critical assets seek to identify possible threats to resources as a way to mitigate harm that could result. It is much easier to identify natural threats such as storms and earthquakes. To a great extent, these threats can be predicted and the possible impact is easier to judge. Plans can be established so that a community is prepared to respond. On the other hand, man-made threats are far less predictable and can occur at any time with unknown consequences, making mitigation and response planning much more difficult.

RISK ASSESSMENT

Risk assessments of critical assets are carried out as a way to identify potential risks that may exist surrounding an asset, which can then lead into developing courses of action to prevent or respond to an attack. Through data collection and analysis, a risk analysis is an attempt to identify not only threats, but also consequences of an attack. In general, a risk assessment asks, "What can go wrong? What is the likelihood that it will go wrong? What are the possible consequences if it does go wrong?"[19] This way, the probability of an incident occurring and the severity (consequence) of that incident will be better understood (see Note 7, pp. 3–7). The analysis can also be used to determine priorities, or what assets are more critical and how should money be spent to protect them. It can also help officials create plans to protect residents and keep their property safe.

Since the September 11, 2001 attack and Hurricane Katrina, public interest in risk analysis has grown dramatically. Risk analysis has become an effective and comprehensive procedure to reduce the possibility of an attack and subsequent damages, and they have become complex.[20] Government officials at the federal, state, and local levels, heads of agencies, and even legislators now incorporate risk analysis into their decision-making processes and address risk more explicitly at all levels.[21]

Risk assessments are completed on an asset, a network, or a system. They typically consider three components of risk as noted earlier, and rely on a variety of methods, principles, or rules to analyze the potential for harm. Some risk assessments are heavily quantitative and rely heavily on statistics and probabilities, whereas others are less quantitative.[22] In general, a risk assessment report typically includes five elements. They are as follows:

1. Identification of assets and a ranking of their importance
   The first step in a risk analysis is to determine which infrastructure assets can be considered to be "critical." Since all assets vary as to how important they are, assets can be, and need to be, ranked. Officials must determine what properties are needed in a community to ensure services are required. Examples include buildings, water treatment plants, or power plants. They may also decide that certain people are critical, such as medical professionals, police officials, or government officials. Another possibility is to include information such as financial data or business strategies. Risk assessments are then done on those assets that are identified as the most critical. The time and resources that would be needed to replace the lost asset must also be part of the analysis. If that asset were lost, how quickly could it be replaced? Are there other assets that could substitute for that one? If the asset was lost, how would services be provided? What cascading effects might occur if one asset were lost or damaged? (see Note 22).
2. Identify, characterize, and assess threats
   All potential threats to an asset need to be identified. Details about potential threats that should be considered include the type of threat (e.g., insider, terrorist, or natural threat); the attacker's motivation; potential trigger events; the capability of a person to carry out an attack; possible methods of attack (e.g., suicide bombers, truck bombs, cyberattacks). Analysts can gather information on these topics from the intelligence community, law enforcement officials, specialists and experts in the field, news reports in the media, previous analysis reports, previously received threats, or "red teams" who have been trained to "think" like a terrorist (see Note 22).
3. Assess the vulnerability of critical assets to specific threats
   An asset's vulnerability can be analyzed in many ways. The first is physical. Here, an analyst would determine things like an

outsider's accessibility to an asset. The second is technical, which refers to an asset's likelihood of being the victim of a cyberattack or other type of electronic attack. The third type of vulnerability is operational, or the policies and operating procedures used by the organization. The fourth is organizational, or the effects that may occur if a company's headquarters is attacked (see Note 22).

4. Determine the risk
   Risk is the chance that a disruptive event may occur, as described earlier. Assets are usually rated on their risk, and resources can be allocated to reduce an asset's risk.
5. Identify and characterize ways to reduce those risks
   An important part of a risk assessment is to determine ways to mitigate or eliminate the risk of an attack. This could be something as simple as banning unauthorized people from entering particular areas or reducing traffic around an asset. Of course, other ways to eliminate the risk of an attack may be more complicated such as building physical barriers or relocating assets.

RISK MANAGEMENT

In risk management, officials ask, "What can be done? What options are available and what are the associated tradeoffs in terms of cost, risks, and benefits? What are the impacts of current management decisions on future options?"[23] These are efforts to decide which protective measures to take based on an agreed upon risk-reduction strategy.

CONVERGENCE

Many of the critical infrastructure assets are connected to each other in some way. This integration of infrastructure is called "convergence." This means that if one asset is harmed and unable to serve people, the other assets linked to it may also be unable to perform (see Note 17, p. 31). This is referred to as "cascading" or "escalating" effects. The interconnected nature of critical infrastructure could lead to even more harm to a community than if the assets were independent. In some cases, the interdependencies can be global since many of our assets are linked to those around the world.

An obvious example of convergence can be seen with cyber assets, which is linked to all other assets both in the US and elsewhere. Computers have become an essential part of our society, and every other sector relies, at least in part, on information technology (IT). A cyberattack may affect the power grid, water, financial services, and healthcare, causing great damage in both the short and long term. It would also affect transportation and financial outlets, thus having an impact on the economy. Computer systems control equipment in the chemical, nuclear, and oil industries. Companies rely on IT for an easy communications, personnel management, research, and online commerce. The computer network is so essential that, in the Comprehensive National Initiative, cybersecurity was identified as one of the most serious economic and national security challenges facing the US. Those assets that are interconnected to other assets and networks may be an attractive target for enemies because of the broad harm it may cause.

On the other hand, interconnected assets could be a benefit for communities. In the case that one sector is unable to provide a service, another asset may be able to step in so that there is minimal disruption and the desired level of service can be provided. So clearly, the interconnected nature of critical infrastructure has both positive and negative components.

RECOVERY/RESILIENCY

In the event that an attack or other disaster does occur, a community must take steps to return to "normal," or to the conditions that existed prior to the event and subsequent disruption of services. This process is called Recovery and is part of the emergency management all-hazards response cycle. Recovery has been defined as the ability to adapt and withstand the disruption that occurs after an emergency or event (see Note 8, p. A-2). It is the ability to recover rapidly and bounce back, or regroup, after a disruption, which could be either natural, technological, or human-caused.[24] In most cases, community agencies and facilities are able to return to their full capabilities in a reasonable amount of time after an event. However, in many cases, the costs of rebuilding are too high and it becomes impractical to return to pre-event standards.[25]

A similar concept is resiliency, which refers to the ability of a community to resist, absorb, recover from, or adapt to a change in conditions. As part of the risk management process, resiliency is "the capacity of an

organization to recognize threats and hazards and make adjustments that will improve future protection efforts and risk reduction measures." This has to do with a community making changes to reduce the risk of an event or consequences of that event.[26] For example, communities may take steps to ensure that facilities are constructed so that they are able to withstand damage to, or the loss of, a supporting beam or column.[27]

Resiliency is made more difficult because, in many cases, when one infrastructure is impacted, others may be impacted alongside (convergence). Each system is interconnected to many other infrastructures, whether it be cyber, physical, or organizational, making them interdependent. These relationships are constantly changing. A risk to one subset becomes a risk to all (see Note 16, p. 684).

At the same time, however, if one infrastructure is damaged or lost, it can be offset by another infrastructure. If one is damaged, another infrastructure may be able to reallocate their services in a way to fill in the gap and reduce the impact caused by the event. For example, if the water supply is damaged, people in that community are less concerned with whether the water is coming through a central pipe or some peripheral parts of the system. Instead, residents are concerned if the water supply fails to provide water to their homes at all.

Beyond allowing a community to continue to provide services, resiliency also has a deterrent value, or a protective value. If a community is well protected and is prepared to bounce back quickly, an attacker, whose goal it is to disrupt services, may be deterred from attacking. An offender may look at the target's protection when considering a target, and if that target is one that will not fall prey to an attack, the offender may go elsewhere.

A community's resiliency is made up of robustness (strength), resourcefulness (innovation, ability to adapt), and recovery. Robustness (R1) refers to the inherent strength in a structure or system, or its ability to withstand external damage without loss of functionality.[28] Resourcefulness (R2) is the capacity to mobilize needed resources and services in emergencies, and recovery (R3) is the ability to return to a "normal" condition. This can be portrayed in the following:

$$R1 + R2 + R3 = \text{Resilience}$$

Some officials have indicated a fourth factor that should be included in this equation, which is Rapidity, or the speed with which disruption can be overcome and safety, services, and financial stability restored.[29] Certainly, residents want essential services such as power and water restored as quickly as possible in order to return to a "normal" state.

RESOURCEFULNESS

Resourcefulness refers to the ability of a community to gather and coordinate any necessary resources, services, equipment, and personnel in the event of a damaging event. Those communities that are resourceful are able to recover more quickly than others. Some essential parts to this include identifying personnel and equipment that might be critical to a recovery operation; cross training so that first responders can respond quickly to more than one type of event; mutual aid agreements that allow agencies to share resources and ask for help under particular circumstances; purchasing of spare equipment so that there is never a gap in available resources; and maintaining a supply of personnel and equipment that could quickly respond when needed (see Note 25).

HAZARD

A hazard is a source or cause of harm (see Note 19, p. 17). There are different types of hazards. A natural hazard is a potential incident resulting from acts of nature or a weather phenomenon.[30] These would be incidents that are caused by acts of nature such as hurricanes, wildfires, avalanches, earthquakes, winter storms, tornadoes, disease outbreaks, or epidemics (see Note 30, p. 5). Another type of hazard is a technological hazard. These are potential incidents that are the result of accidents or failures of systems or structures (see Note 30, p. B-1). Examples of these include hazardous materials releases, dam or levee failures, an airplane crash, power failure, or radiological release (see Note 30, p. 6). These may be caused by human error or a failure of technology. The final type of hazard is human-caused hazard, which include incidents that are the result of intentional actions of an individual or group of individuals. Examples of this type of hazard include acts of terrorism, an active shooter, biological attacks, chemical attack, cyber incident; a bomb attack, or a radiological attack (see Note 30, pp. B-1, 6).

The "all-hazards" approach is a way to analyze and prepare for a full range of threats and hazards, including domestic terrorist attacks, natural and man-made disasters, accidental disruptions, and other emergencies (see Note 25. pp. 2–5). This is a "grouping classification encompassing all conditions, environmental or man-made, that have the potential to cause injury, illness, or death; damage to or loss of equipment, infrastructure services, or property; or alternatively causing functional degradation to social, economic, or environmental aspects" (see Note 7, p. A-2).

IMPACTS

Impacts describe how an event might affect an asset or the impact it has on the provision of services to residents. An impact could be the damage caused by an event, or the consequences that occur as the result of an event. Impacts are clearly linked to the size and complexity of an event—a more serious event will result in more serious impacts. In a risk analysis, the possible impacts identified should be specific in order to allow officials to have a better understanding of how to manage the risk (see Note 30, p. 11).

PREPAREDNESS

Preparedness has been defined as those activities that are "necessary to build, sustain, and improve readiness capabilities to prevent, protect against, respond to, and recover from natural and man-made incidents." Preparedness is a continuous process whereby vulnerabilities are continually being assessed and response plans continually being updated and revised. Preparedness can be completed by officials at all levels of government and between government and private sector and nongovernmental organizations. As described in the National Incident Management System (NIMS), preparedness has to do with establishing guidelines, protocols, and standards for planning, training and exercises, personnel qualification and certification, equipment certification, and publication management (see Note 7, pp. 1–11).

CYBERSECURITY

The term "cybersecurity" refers to actions that are taken by government or by private owners and operators to prevent damage to, unauthorized use of, or exploitation of, information and communications held electronically. This also includes all actions geared toward restoring these systems after an attack or other harm. The goal of this sector is to ensure the confidentiality, integrity, and availability of online information and data. Activities regarded as cybersecurity include those that are intended to protect and restore information networks and wirelines, wireless satellite, public safety answering points, and 911 communications systems and control systems (see Note 7, p. A-2).

MITIGATION

Mitigation refers to lessening the impact of an event. All communities should develop plans that have the goal of reducing the potential impact of a natural or man-made event. Once a community completes the assessment report that identifies risks and vulnerabilities, officials should devise a mitigation plan. All members of a community should be invited to participate in making the plan, as well as private stakeholders. The plan should define the roles and responsibilities of all interested organizations and individuals. It may also include mutual aid agreements with other jurisdictions or memorandums of understanding that will help ensure that the plan is carried out when needed (see Note 25, pp. 6–16). Some examples of mitigation measures that communities have taken to improve the safety of a facility include increasing physical security measures, hiring additional security guards, and installing barriers around a building. Examples of mitigating cybersecurity measures include enhancing firewalls and updating passwords.

Training is essential to mitigation efforts. Personnel can train on equipment, become familiar with policies, learn to communicate, and work with other agencies. Training exercises that simulate emergencies are important as agencies can assess how well they have planned. Since threats can change, exercises will keep people ready to react (see Note 25, pp. 6–17, 18). This way, when an event occurs, people will be ready and able to assist.

CONCLUSION

This book examines the government's role in identifying and protecting the nation's critical infrastructure as they seek to protect the country from harm and ensure that essential services and goods are available in the aftermath of a disruptive event. It will focus on risk assessment of assets and the development of plans to protect the nation's infrastructure from damage resulting from both natural disasters and attacks. The purpose is to introduce these ideas to the readers in a way that is easy to understand rather than with the use of complicated formulas.

A history of risk assessment and programs for critical infrastructure protection is given in Chapter 2. This helps to give readers a background into early government policies that form the basis of today's asset protection programs. The status of today's protection plans is the

focus of Chapter 3. The role of the DHS in critical infrastructure protection is described in Chapter 4, and Chapter 5 provides information on other agencies that help the nation in these efforts. The importance and status of public–private partnerships is presented in Chapter 6. This is of particular importance because a great portion of our country's assets are privately owned. The information in Chapter 7 summarizes the laws pertaining to critical infrastructure protection that have been passed by Congress. Chapter 8 presents the DHS perspective on risk and details three key documents which were created to define the principles, processes, and operational practices of risk management. Chapter 9 provides an overview of earlier risk assessment methods, federal guidelines for risk, and application of the Threat and Hazard Identification and Risk Assessment (THIRA) process. Chapters 10 through 12 summarize the 16 critical infrastructures and their sector-specific agencies. In this section, each chapter provides a sector profile, goals and priorities, and the various methods and approaches each sector takes to assess risk. The text concludes with a discussion of the issues that continue to challenge and shape our responses to critical infrastructure protection, risk management, and resilience efforts in Chapter 13.

REVIEW QUESTIONS

1. Why is it important for the US to protect its CIKR?
2. What is critical infrastructure?
3. Why would a government or agency carry out a risk assessment?
4. What are the elements of a risk assessment?
5. Why would a community be interested in recovery and resiliency?

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