

Chapter 2

Natural and Technological Hazards and Risk Assessment

A hazard is defined as a “source of danger that may or may not lead to an emergency or disaster and is named after the emergency/disaster that could be so precipitated.” Risk is defined as “susceptibility to death, injury, damage, destruction, disruption, stoppage, and so forth.” Disaster is defined as an “event that demands substantial crisis response requiring the use of governmental powers and resources beyond the scope of one line agency or service.” And ultimately, when the response requirements in one or more critical areas of assistance are unable to be met at all levels of government responding, the incident is classified as a catastrophe.

Hazard identification is the foundation of all emergency and risk management activities. When hazards interface with the human or built environments, it is risk that results. Understanding the risk posed by identified hazards guides the process for preparedness planning and mitigation. Risk, when realized, becomes a disaster that prompts emergency response and recovery activities. All emergency management activities are predicated on the identification and assessment of hazards and risks.

Natural Hazards: Natural hazards are those that exist in the natural environment and pose a threat to human populations and communities, and these hazards are often exacerbated by irresponsible human development. The following are the most common natural disasters:

- Floods are the most frequent and widespread disaster in many countries, caused by several factors including prolonged precipitation (most common), intense thunderstorms, snowmelt, ice jams, and dam failures. Exposure to floods is great due to historical human settlement around rivers and ports
- Earthquakes are sudden, rapid shaking of the earth caused by the shifting of the Earth’s crustal plates. These hazards often spark secondary hazards such as landslides, tsunamis, fires, and floods. Millions of people live in active seismic zones around the world, ranging in vulnerability based primarily upon the construction type of the buildings within which they live and work. The Richter and Modified Mercalli scales have been developed to measure earthquakes’ intensities and consequences.
- Hurricanes evolve from tropical storms, and strike with winds greater than 74 mph, storm surges, and heavy rains. In general, hurricanes occur between June 1 and November 30th, peaking in August and September. The destructive power a hurricane can be spread over wide territories in a relatively short period of time. Modern hurricane tracking technology has improved prediction and mitigation capabilities and reduced the loss of life. However, financial consequences from these storms continue to increase. Hurricane intensity is measured according to the Saffir-Simpson Scale.
- Storm surges are rises in sea levels caused by storms that generate destructive, erosive waves and flooding.
- Tornadoes are rapidly rotating funnels of air spawned by thunderstorms that occur approximately 1,000 times each year. The few that touch ground cause extensive destruction when they interact with humans or the built environment. Building collapse and flying debris are the principal causes of death and injury. The greatest incidence of tornadoes exists in the Midwestern ‘tornado alley’, striking primarily from March through August, and in the afternoon or early evening. Tornado prediction technology has improved warning ability

significantly, while safe-room construction has reduced consequences. Tornadoes are measured according to the Fujita-Pearson Tornado Scale.

- Wildfires are classified as surface-, ground-, or crown-fires, these hazards continue to threaten residential areas to a continually increasing degree. Land charring can lead to secondary landslides, mudflows, and floods, and widespread erosion. Severe drought conditions and detritus buildup contribute to the 'fuel' availability that determines risk.
- Landslides occur when debris moves down a slope. Slides are activated by storms, fires, seismicity, human interaction, or natural erosive processes. Speed and size varies significantly. Mudslides are landslides saturated with water. Landslide risks are well understood and can be both mapped and mitigated with relatively high success.
- Tsunamis are masses of water generated by undersea disturbances such as earthquakes, landslides or volcanoes that are capable of traveling thousands of miles at astonishing speed. Tsunamis become dangerous when they reach developed ocean coasts, most significantly those areas that are below 50 feet elevation and within one mile of the shoreline.
- Volcanic Eruptions result when pressurized magma or gasses are expelled through the Earth's crust. Eruptions can be persistent or explosive, and often cause numerous secondary disasters such as mudslides, floods, tsunamis, and earthquakes, among others.
- Severe Weather Storms consist of extreme cold, heavy snow or ice, as well as high winds if the storm is a blizzard. These storms' origins depend upon where they are formed.
- Droughts are slow onset hazards characterized by a severe shortage of water.
- Extreme Heat is defined as temperatures that hover 10 degrees or more above the local average that last for several weeks.
- Coastal Erosion is measured as the rate of change in the position or horizontal displacement of a shoreline over a period of time, generally associated with severe coastal storms.
- Thunderstorms are generated by atmospheric imbalance and turbulence and cause flash flooding, winds, hail, lightning, and tornadoes.
- Hailstorms are the precipitation of ice balls greater than .75-inch diameter associated with severe thunderstorms. Hail causes nearly \$1 billion in property and crop damages annually.
- Avalanches are high velocity sliding snow or ice masses, occurring approximately 10,000 times per year, affecting approximately 144 people and causing about \$500,000 in damages.
- Land Subsidence is a loss of surface elevation caused by the removal of subsurface support.
- Expansive Soils are the swelling of soil and soft rock caused by changes in moisture content.
- Dam Failures are disasters resulting from neglect or as result of another disaster.

Technological Hazards

- Fires can be anthropomorphic, or can be secondary to other natural hazards
- Hazardous Materials Incidents involve the release or misuse of chemical substances that can threaten life and the environment.
- Nuclear Accidents result in the release of highly radioactive material into the environment, and can cause widespread death and destruction.
- Terrorism is the use of force or violence against persons or property, generally for the purpose of inciting fear to instigate civil unrest or draw attention to a cause. Terrorism, and war, can involve potentially catastrophic Biological, Chemical, Radiological, and Nuclear Weapons, often called "Weapons of Mass Destruction" (WMDs).

Hazards Risk Management is the processes by which individuals, communities, and countries deal with the hazard risks they face. Assessments can be qualitative or quantitative, and are dependant upon data accuracy. The process involves hazard identification, hazard risk assessment, hazard risk analysis, and hazard risk treatment. Risk treatment technologies have improved our ability to manage risk considerably over the past fifteen years, and has included such things as imaging and sensing systems, modeling, communication systems, and mapping.

Social and Economic Risk Factors can greatly influence hazard risk. Little has been done to address social and economic risk factors domestically, as risk assessments generally consider populations to be homogeneous. The importance placed on considering the special needs of certain 'special populations' has grown since hurricane Katrina brought such topics to light.

Essay Questions

1. Define the terms *Hazard*, *Risk*, and *Disaster*.
2. Compare and contrast natural and technological hazards, providing examples to illustrate your answer.
3. Explain whether exposure to hazards is increasing or decreasing in the United States.
4. Explain how social and economic factors contribute to increases or decreases in the vulnerability of a population.
5. Explain the four steps of Hazard Risk Management as defined in this chapter.