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Jean Monnet Module: Disaster Risk Management

Hazard Identification

Outline of presentation:

1. *Hazard profiling*
2. *Hazard analysis*
3. *Natural Hazards*
4. *Technological Hazards*
5. *Intentional Hazards*

| First Part
Hazard profiling and hazard analysis

Hazard identification

- The first steps that must be taken in any effective disaster management effort are the identification and profiling of hazards.
- Disaster managers need worry only about those that have a non-negligible likelihood of occurrence and that are damaging or devastating should they occur
- hazard assessment must include not only the actual physical hazards that exist but also the expected secondary hazards, including social reactions and conditions.
- Ideally, all hazards with likelihood greater than zero are identified so that their associated risks may be reduced later in the risk management process, and only after hazard risks are measured and rated.

Hazard identification

- Hazards can be categorized into several subgroups:
  - natural hazards,
  - technological hazards, and
  - intentional hazards
- Some hazards cannot be easily assigned to any one category, and this often leads to confusion in the hazard identification process.
- Hazard risk managers can simplify the process by applying logical conventions to the identification process, such as identifying and categorizing hazards according to their generating forces

Hazard Identification

- For most countries, natural hazards are disaster managers' primary concern. The specific natural hazards faced are dictated by the country's climate, geography, geology, settlement patterns, and land use practices.
- Technological, or man-made, hazards are inevitable products of technological innovation. These hazards, which can occur after the failure of existing technology, tend to be much less understood than their natural counterparts and are increasing in number as the scope of and dependence on technology expands.
- The third category is intentional hazards, which include those hazards that result from the conscious decisions of people to act in an antisocial or anti-establishment manner.

Hazard Identification

- Hazard identification must be exhaustive to be effective.
- Hazard identification initiates hazard profiling, which is the process of describing a hazard in its local context.
- There are several methods by which hazard identification occurs:
  - Brainstorming
  - Historical research
  - Review of existing plans and strategies
  - Investigation of hazard identification efforts in surrounding or similar areas
  - Use of maps
  - Interviews
  - Site visits to public or private facilities
  - Check Lists (Later in the process)

Hazard Identification

- Identification of secondary hazards:
  - event trees and fault trees

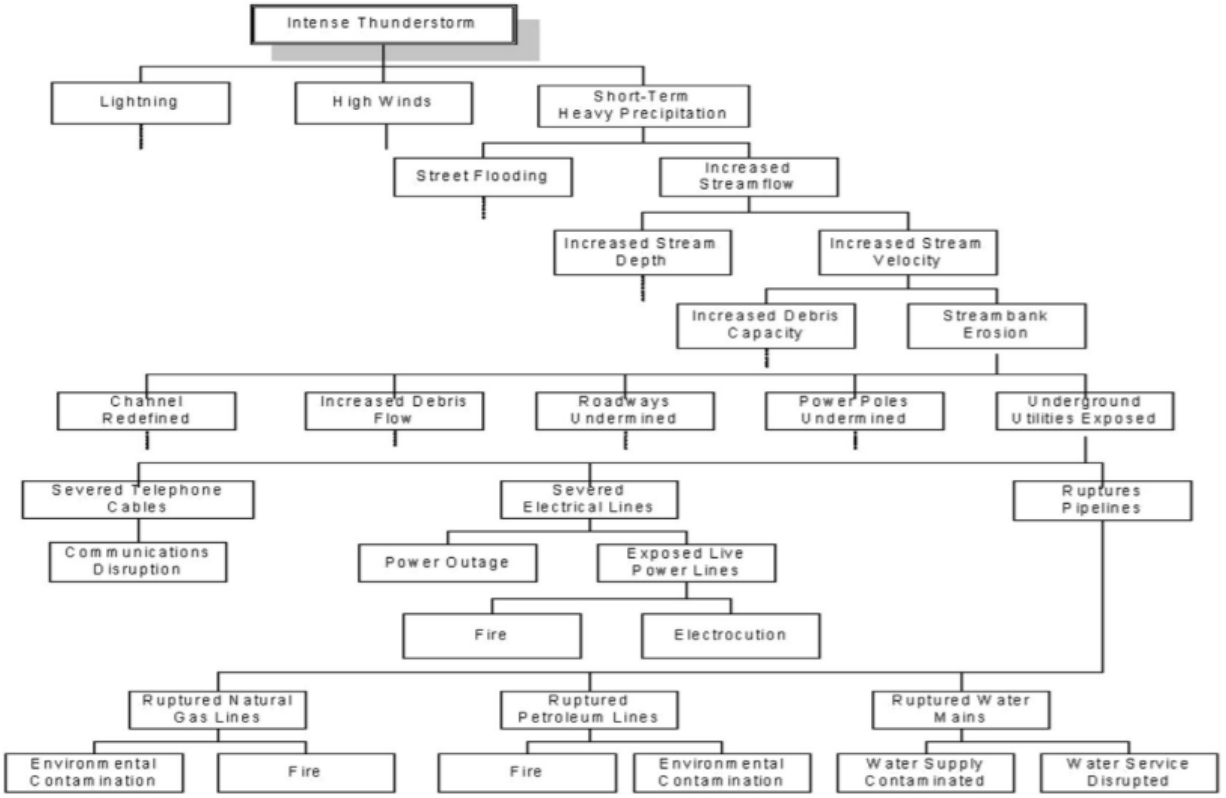


FIGURE 2.1

Event tree

Adapted from NRC, 1991.

Hazard Identification

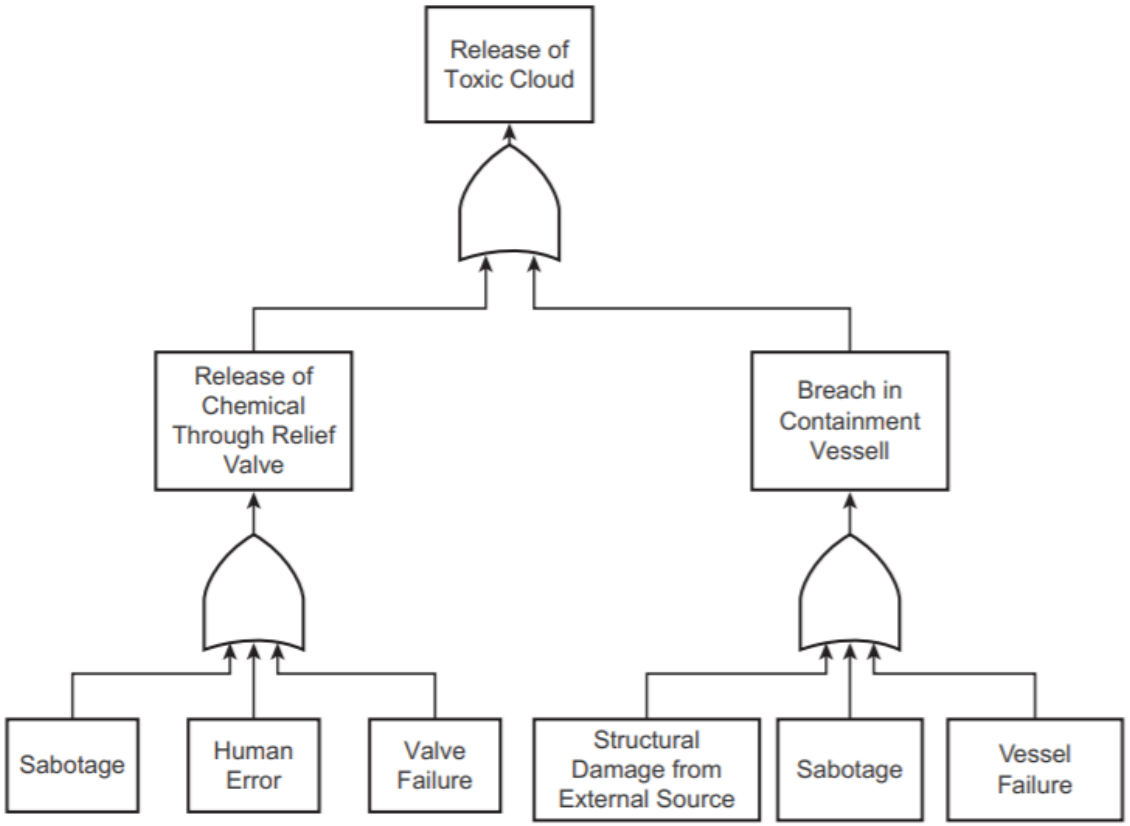


FIGURE 2.3

Fault tree

Adapted from Slovic et al., 1979.

Hazard Analysis

- Once hazards are identified, further description is required for the analysis of risk that follows.
- This descriptive process, called hazard analysis or hazard profiling, enables more informed calculations of risk upon which disaster management actions may ultimately be taken
- Disaster managers commonly create what are called risk statements, which succinctly summarize all of the necessary information for each identified hazard in a manner that communicates cause and effect wherein the hazard affects an element at risk
- Risk profiles are more detailed reports that provide a wide range of tailored information about how the hazard impacts the area of study

Risk Maps

- Geography. This includes topography, mountains, bodies of moving and standing water, canyons, coastal zones, tectonic faults, and other features.
- Property. This includes land use, construction type, essential facilities, and hazardous materials facilities, among others. • Infrastructure. This includes roads, rail lines, airports, utilities, pipelines, bridges, communications, hospitals, schools, and mass transit systems, among others.
- Demographics. This includes population size, density, income levels, and special population designations (such as elderly, children, prisons), among others.
- Response capacity. This includes the locations, facilities, services, and assets of fire, police, emergency management, military, public health, and other response systems.

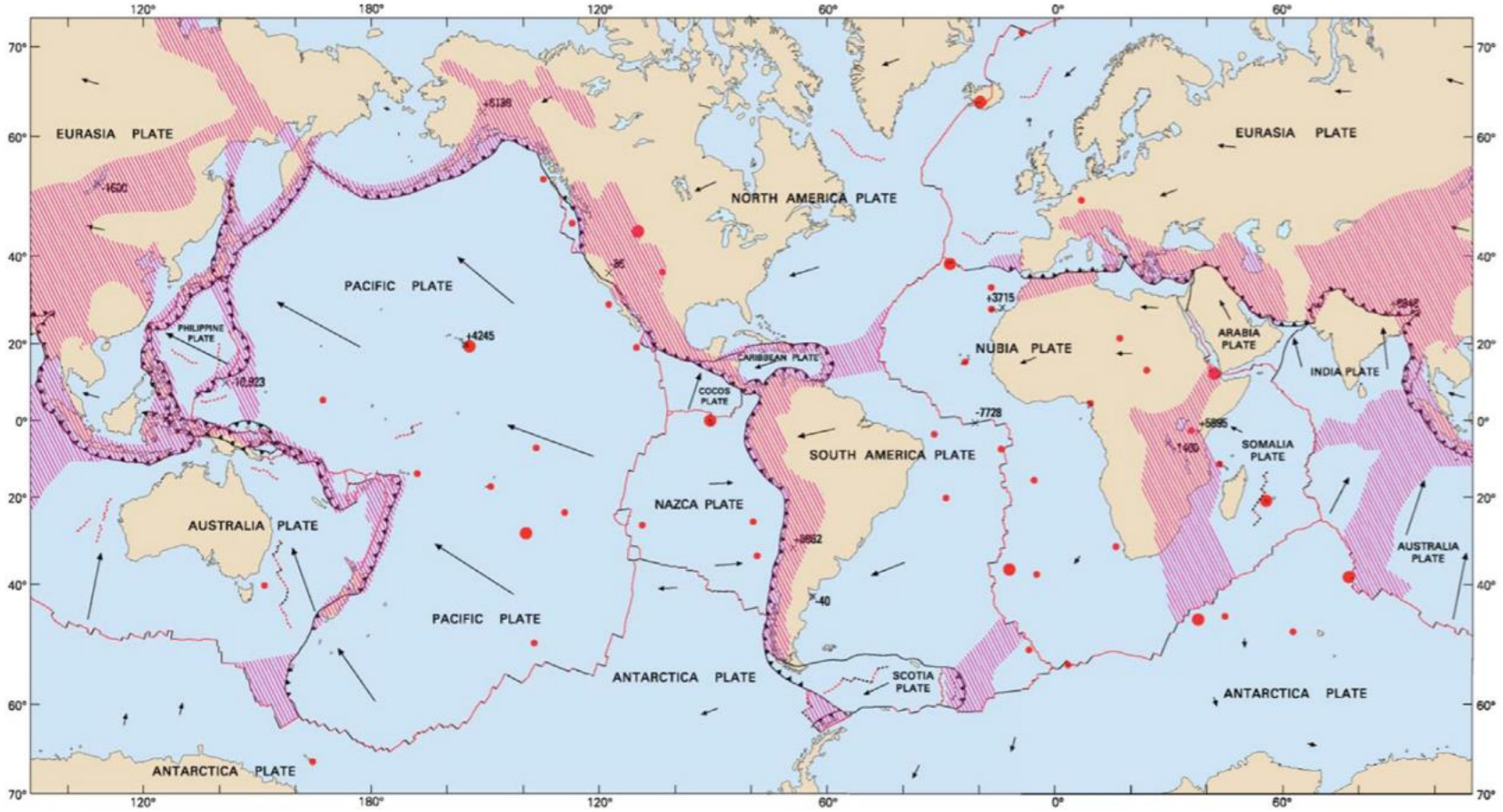
Risk statements

- Name of the hazard
- General description of the hazard
- Frequency of occurrence of the hazard
  - Historical incidences of the hazard
  - Predicted frequency of the hazard
  - Magnitude and potential intensity of the hazard
  - Location(s) of the hazard
  - Estimated spatial extent of impact of the hazard
  - Duration of hazard event, emergency, or disaster
  - Seasonal pattern or other time-based patterns of the hazard
  - Speed of onset of the hazard event
  - Availability of warnings for the hazard

|Second Part
Natural Hazards

Tectonic Hazards

- Hazards that are associated with the movement of the earth's plates are called tectonic or seismic hazards.



Tectonic Hazards

- Earthquakes, as the term suggests, are sudden movements of earth caused by an abrupt release of strains that have accumulated over time along fault lines
- Seismic waves are generated by the jolting motion of the plates.
- Many secondary hazards and the disasters they cause are known to occur in the aftermath of earthquakes.

Table 2.1 Annual Occurrence of Earthquakes

Descriptor	Magnitude	Average Annually
Great	8 and higher	1[a]
Major	7–7.9	17[b]
Strong	6–6.9	134[b]
Moderate	5–5.9	1,319[b]
Light	4–4.9	13,000 (estimated)
Minor	3–3.9	130,000 (estimated)
Very minor	2–2.9	1,300,000 (estimated)

[a]*Based on observations since 1900.*
[b]*Based on observations since 1990.*
Source: USGS, 2005a.

Tectonic Hazards

- Beneath the earth's crust lie superheated gases and molten rock called magma.
- At certain points along the planet's crust—most notably in the seismically active zones along the plate boundaries—magma can escape to the surface and become lava.
- These fissures, or vents, are known as volcanoes.
- There are currently over 500 active volcanoes throughout the world
- Volcanoes are categorized in two ways:
  - According to their geologic environment
  - According to their shape and composition
- Many secondary hazards are associated with volcanoes

Tectonic Hazards

- A tsunami (pronounced “soo-nah-mee”) is a series of waves generated by an undersea disturbance such as an earthquake
- There are many events that result in the generation of a tsunami, but earthquakes are the most common. Other forces that generate these waves include landslides, volcanic eruptions, explosions and, although extremely rare, the impact of extraterrestrial objects such as meteorites.
- Tsunamis are generated when a large area of water is displaced, either by a shift in the seafloor during an earthquake or by the introduction of mass or pressure from other events.

Mass-movement Hazards

- Mass-movement hazards include those events that are caused by either the rapid, gravity-induced downward movement of large quantities of materials (debris movements) or the contraction (subsidence) or expansion of the earth from non-seismic means.
- Debris Movements include: Landslides, Rockfalls, mudflows or mudslides, Avalanches
- Flooding is a common secondary hazard associated with debris movements. A debris movement can also trigger a tsunami if its runoff zone terminates in a large body of water
- Land subsidence is a loss of surface elevation caused by the removal of subsurface support.
- Expansive soils are soils that tend to increase in volume when they are influenced by some external factor, especially water.

Hydrologic Hazards

- Floods
  - River floodplains.
  - Basins and valleys affected by flash flooding
  - Land below water-retention structures (dams)
  - Low-lying coastal and inland shorelines
  - Alluvial fans.
- Droughts
  - Meteorological drought.
  - Agricultural drought.
  - Hydrological drought.
  - Socioeconomic (famine) drought.
- Desertification
  - Poor land management
  - Increased population and livestock pressure on marginal lands accelerate the process.

Meteorological Hazards

- Meteorological hazards are related to atmospheric weather patterns or conditions.
- These hazards are generally caused by factors related to precipitation, temperature, wind speed, humidity, or other more complex factors.
- As all of the world's people are subject to the erratic nature of weather, there exists no place on earth that is truly safe from the effects of at least one meteorological hazard.
- The greatest range of natural hazards fall into this general category.

Meteorological Hazards

- Tropical cyclones (hurricanes, typhoons, etc)
- Monsoons
- Tornadoes
- Ice storms
- Snow Storms
- Blizzards
- Hailstorms
- Frost
- Extreme cold temperatures
- Extreme heat
- Windstorms
- Sandstorms
- Wildfire
- Thunderstorms
- Fog
- El Nino/La Nina
- Climate Change

Biological/Health-Related Hazards

- Biological hazards is an umbrella grouping that includes threats derived from live pathogens or the byproduct of living things that cause or are related to disease and death in plants, animals, and humans.
- Human epidemics - Epidemics are often defined by their geographical range, which can include a community, a country, or even the entire globe (called a pandemic)
- Epidemics can arise quickly or gradually, and can be halted quickly or persist for decades.
- Statistically speaking, epidemics remain the greatest killers of humans.
- Livestock or animal epidemics, including those in aquatic environments, refer to epidemics that affect the life of any animal other than humans
- Plant and agricultural epidemics threaten to cause both economic and environmental damage

Other Natural Hazards

- Meteorite strikes
- Poisoning
- Soil Salination
- Space Weather
- Animal Attacks

|Third Part
Technological Hazards

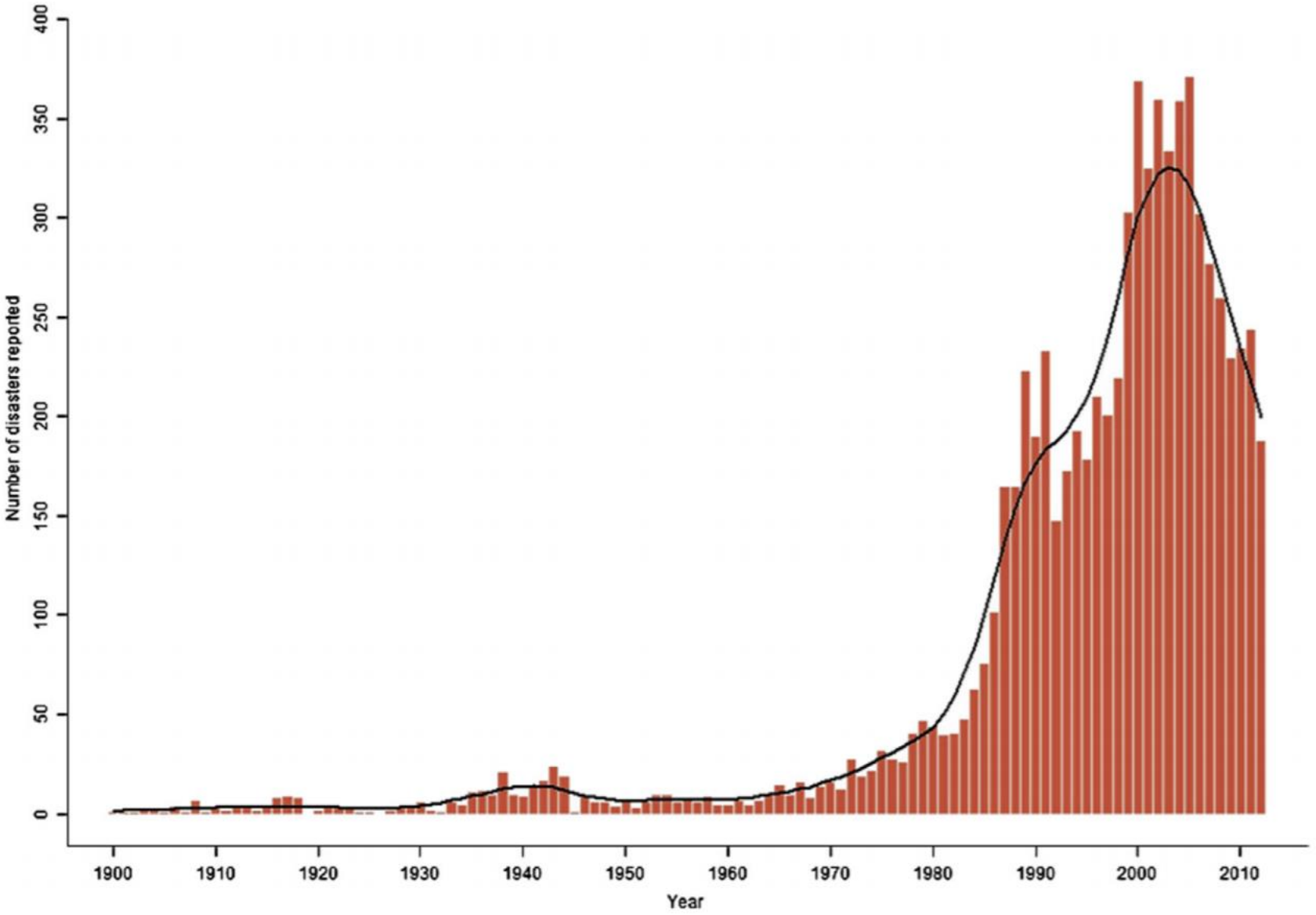


FIGURE 2.33

Total number of reported technological disasters between 1900 and 2012

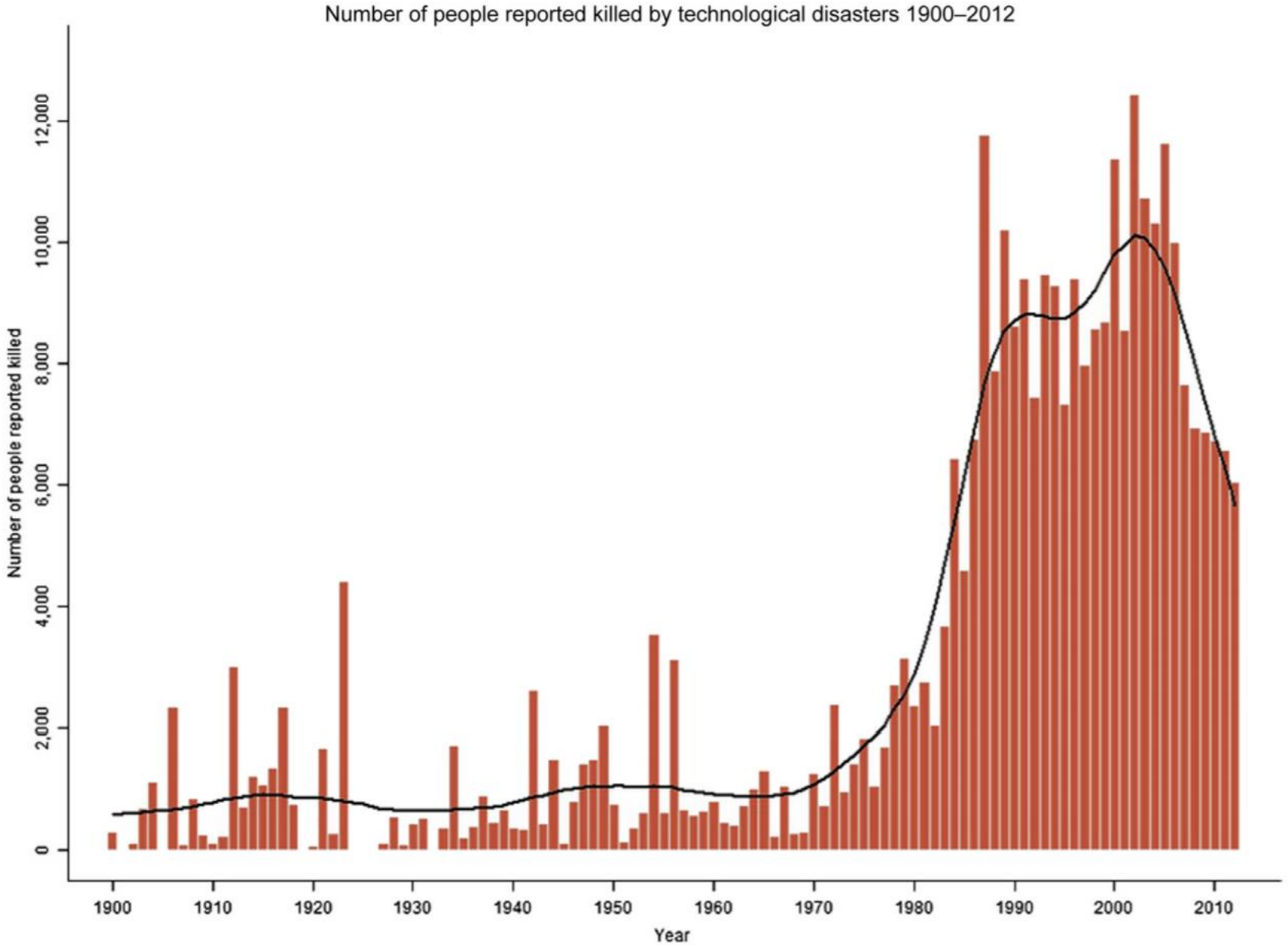


FIGURE 2.34

Total number of people killed in technological disasters between 1900 and 2012

Source: International Disaster Database.

Transportation Hazards

- Transportation infrastructure disasters
- Airline accidents
- Rail accidents
- Maritime accidents
- Roadway accidents

Infrastructure Hazards

- Power failures
- Telecommunications systems failures
- Computer network failure
- Critical water or sewer system failures
- Major gas distribution line (main) breaks
- Dam failure
- Food shortage
- Overburdened public health facilities
- Economic failure

Other technological hazards

- Industrial Hazards
  - Hazardous materials processing and storage accidents
  - Raw materials extraction accidents (including mining accidents)

- Structural Fires

Fourth Part
Intentional Hazards

Intentional Hazards

- Terrorism
  - Nationalist Terrorism
  - Religious
  - State-sponsored
  - Left wing
  - Right wing
  - Anarchist
- Explosives
- Chemical agents
- Biological agents
- Nuclear and radiological weapons
- Cyberterrorism
- Narcoterrorism
- Civil unrest
- Crime
- War
- Complex humanitarian emergency

Literature and references

- Coppola (2015) Introduction to international Disaster Risk Management, Chapter 2