

HISTORICAL PERSPECTIVE AND OVERVIEW

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SAFETY AND HEALTH MOVEMENT, THEN AND NOW

LEARNING OBJECTIVES

- ▶ Summarize key developments relating to workplace safety and health prior to the industrial revolution
- ▶ List the most important milestones in the safety movement
- ▶ Explain how workplace tragedies have changed the safety movement
- ▶ Describe the role of organized labor in the safety movement
- ▶ Describe the roles specific health problems have played in the safety movement
- ▶ Explain how safety and health standards apply to more than just manufacturing
- ▶ Describe the development of accident prevention programs as part of the safety movement
- ▶ Describe the safety and health movement today
- ▶ Explain the integrated approach to safety and health
- ▶ Describe how new materials, new processes, and new problems are effecting the safety and health movement today
- ▶ Summarize the rapid growth that has occurred in the safety and health profession
- ▶ Explain how the movement of manufacturing jobs overseas has affected the accident rate in the United States

The **safety movement** in the United States has developed steadily since the early 1900s. In that time period, industrial accidents were commonplace in this country; for example, in 1907, more than 3,200 people were killed in mining accidents. Legislation, precedent, and public opinion, all favored management. There were few protections for workers' safety.

Working conditions for industrial employees today have improved significantly. The chance of a worker being killed in an industrial accident is less than half of what it was 60 years ago.¹ According to the National Safety Council (NSC), the current death rate from work-related injuries is approximately 4 per 100,000, or less than a third of the rate 50 years ago.²

Improvements in safety until now have been the result of pressure for legislation to promote safety and health, the steadily increasing costs associated with accidents and injuries, and the professionalization of safety as an occupation. Improvements in the future are likely to come as a result of greater awareness of the cost-effectiveness and resultant competitiveness gained from a safe and healthy workforce.

This chapter examines the history of the safety movement in the United States and how it has developed over the years. Such a perspective will help practicing and prospective safety professionals form a better understanding of both their roots and their future.

DEVELOPMENTS BEFORE THE INDUSTRIAL REVOLUTION

It is important for students of occupational health and safety to first study the past. Understanding the past can help safety and health professionals examine the present and future with a sense of perspective and continuity. Modern developments in health and safety are neither isolated nor independent. Rather, they are part of the long continuum of developments in the safety and health movement.

The continuum begins with the days of the ancient Babylonians. During that time, circa 2000 BC, their ruler, Hammurabi, developed his **Code of Hammurabi**. The code encompassed all the laws of the land at that time, showed Hammurabi to be a just ruler, and set a precedent followed by other Mesopotamian kings. The significance of the code from the perspective of safety and health is that it contained clauses dealing with injuries, allowable fees for physicians, and monetary damages assessed against those who injured others.³ This clause from the code illustrates Hammurabi's concern for the proper handling of injuries: "If a man has caused the loss of a gentleman's eye, his own eye shall be caused to be lost."⁴

This movement continued and emerged in later Egyptian civilization. As evidenced from the temples and pyramids that still remain, the Egyptians were an industrious people. Much of the labor was provided by slaves, and there is ample evidence that slaves were not treated well—that is, unless it suited the needs of the Egyptian taskmasters.

One such case occurred during the reign of Rameses II (circa 1500 BC), who undertook a major construction project, the Ramesseum. To ensure the maintenance of a workforce sufficient to build this huge temple bearing his name, Rameses created an industrial medical service to care for the workers. They were required to bathe daily in the Nile and were given regular medical examinations. Sick workers were isolated.⁵

The Romans were vitally concerned with safety and health, as can be seen from the remains of their construction projects. The Romans built aqueducts, sewerage systems, public baths, latrines, and well-ventilated houses.⁶

As civilization progressed, so did safety and health developments. In 1567, Philippus Aureolus produced a treatise on the pulmonary diseases of miners. Titled *On the Miners' Sickness and Other Miners' Diseases*, the treatise covered diseases of smelter workers and metallurgists and diseases associated with the handling of and exposure to mercury. Around the same time, Georgius Agricola published his treatise *De Re Metallica*, emphasizing the need for ventilation in mines and illustrating various devices that could be used to introduce fresh air into mines.⁷

The eighteenth century saw the contributions of Bernardino Ramazzini, who wrote *Discourse on the Diseases of Workers*. Ramazzini drew conclusive parallels between diseases suffered by workers and their occupations. He related occupational diseases to the handling of harmful materials and to irregular or unnatural movements of the body. Much of what Ramazzini wrote is still relevant today.⁸

The Industrial Revolution changed forever the methods of producing goods. According to J. LaDou, the changes in production brought about by the Industrial Revolution can be summarized as follows:

- Introduction of **inanimate power** (i.e., steam power) to replace people and animal power
- Substitution of machines for people
- Introduction of new methods for converting raw materials
- Organization and specialization of work, resulting in a division of labor⁹

These changes necessitated a greater focusing of attention on the safety and health of workers. Steam power increased markedly the potential for life-threatening injuries, as did machines. The new methods used for converting raw materials also introduced new risks of injuries and diseases. Specialization, by increasing the likelihood of boredom and inattentiveness, also made the workplace a more dangerous environment.

MILESTONES IN THE SAFETY MOVEMENT

Just as the United States traces its roots to Great Britain, the safety movement in this country traces its roots to England. During the Industrial Revolution, child labor in factories was common. The hours were long, the work hard, and the conditions often unhealthy and unsafe. Following an outbreak of fever among the children working in their cotton mills, the people of Manchester, England, began demanding better working conditions in the factories. Public pressure eventually forced a government response, and in 1802, the Health and Morals of Apprentices Act was passed. This was a milestone piece of legislation: It marked the beginning of governmental involvement in workplace safety.

When the industrial sector began to grow in the United States, hazardous working conditions were commonplace. Following the Civil War, the seeds of the safety movement were sown in this country. Factory inspection was introduced in Massachusetts in 1867. In 1868, the first barrier safeguard was patented. In 1869, the Pennsylvania legislature passed a mine safety law requiring two exits from all mines. The Bureau of Labor Statistics was established in 1869 to study industrial accidents and report pertinent information about those accidents.

The following decade saw little new progress in the safety movement until 1877, when the Massachusetts legislature passed a law requiring safeguards for hazardous machinery. This year also saw passage of the Employer's Liability Law, establishing the potential for **employer liability** in workplace accidents. In 1892, the first recorded safety program was established in a Joliet, Illinois, steel plant in response to a scare caused when a flywheel exploded. Following the explosion, a committee of managers was formed to investigate and make recommendations. The committee's recommendations were used as the basis for the development of a safety program that is considered to be the first safety program in American industry.

Around 1900, Frederick Taylor began studying efficiency in manufacturing. His purpose was to identify the impact of various factors on efficiency, productivity, and profitability. Although safety was not a major focus of his work, Taylor did draw a connection between lost personnel time and management policies and procedures. This connection between safety and management represented a major step toward broad-based safety consciousness.

In 1907, the U.S. Department of the Interior created the Bureau of Mines to investigate accidents, examine health hazards, and make recommendations for improvements. Mining workers definitely welcomed this development, since more than 3,200 of their fellow workers were killed in mining accidents in 1907 alone.¹⁰

One of the most important developments in the history of the safety movement occurred in 1908 when an early form of **workers' compensation** was introduced in the United States. Workers' compensation actually had its beginnings in Germany. The practice soon spread throughout the rest of Europe. Workers' compensation as a concept made great strides in the United States when Wisconsin passed the first effective workers' compensation law in 1911. In the same year, New Jersey passed a workers' compensation law that withstood a court challenge.

The common thread among the various early approaches to workers' compensation was that they all provided some amount of compensation for on-the-job injuries regardless of who was at fault. When the workers' compensation concept was first introduced in the United States, it covered a very limited portion of the workforce and provided only minimal benefits. Today, all 50 states have some form of workers' compensation that requires the payment of a wide range of benefits to a broad base of workers. Workers' compensation is examined in more depth in Chapter 7.

The Association of Iron and Steel Electrical Engineers (AISEE), formed in the early 1900s, pressed for a national conference on safety. As a result of the AISEE's efforts, the first meeting of the **Cooperative Safety Congress (CSC)** took place in Milwaukee in 1912. What is particularly significant about this meeting is that it planted the seeds for the eventual establishment of the NSC. A year after the initial meeting of the CSC, the

National Council of Industrial Safety was established in Chicago. In 1915, this organization changed its name to the National Safety Council. It is now the premier safety organization in the United States.

From the end of World War I (1918) through the 1950s, safety awareness grew steadily. During this period, the federal government encouraged contractors to implement and maintain a safe work environment. Also during this period, industry in the United States arrived at two critical conclusions: (1) There is a definite connection between quality and safety and (2) off-the-job accidents have a negative impact on productivity. The second conclusion became painfully clear to manufacturers during World War II when the call-up and deployment of troops had employers struggling to meet their labor needs. For these employers, the loss of a skilled worker due to an injury or for any other reason created an excessive hardship.¹¹

The 1960s saw the passage of a flurry of legislation promoting workplace safety. The Service Contract Act of 1965, the Federal Metal and Nonmetallic Mine Safety Act, the Federal Coal Mine and Safety Act, and the Contract Workers and Safety Standards Act, all were passed during the 1960s. As their names indicate, these laws applied to a limited audience of workers.

These were the primary reasons behind passage of the **Occupational Safety and Health Act (OSH Act)** of 1970 and the Federal Mine Safety Act of 1977. These federal laws, particularly the OSH Act, represent the most significant legislation to date in the history of the safety movement. During the 1990s, the concept of total safety management (TSM) was introduced and adopted by firms that were already practicing total quality management (TQM). TSM encourages organizations to take a holistic approach to safety management in which the safety of employees, processes, and products is considered when establishing safe and healthy work practices.

At the turn of the century, workplace violence including terrorism began to concern safety and health professionals. In addition, the twenty-first century saw a trend in which older people were returning to work to supplement their retirement income. This trend led to a special emphasis on the safety and health of older workers. A more recent trend is greater concern of U.S. companies for the safety and health of employees in foreign countries that manufacture goods that are sold in the United States.

The Superfund Amendments and Reauthorization Act was passed by Congress in 1986, followed by the Amended Clean Air Act in 1990; both were major pieces of environmental legislation. Another milestone that occurred in the decade of the 1990s was the trend toward safety professionals making ergonomics part of their overall approach for preventing accidents and injuries. Ergonomics involves fitting the work to the worker rather than the worker to the work. It is concerned with, among other things, the prevention of musculoskeletal disorders and injuries.

Figure 1–1 summarizes some significant milestones in the development of the safety movement in the United States.

TRAGEDIES THAT HAVE CHANGED THE SAFETY MOVEMENT

The pace of the safety and health movement in the United States has been accelerated by the occurrence of workplace tragedies. These tragedies could have been prevented had appropriate safety and health measures been followed. Unfortunately, they were not. This section summarizes some of the more significant of these workplace tragedies; tragedies that have had a lasting effect on the safety and health movement.

Hawk's Nest Tragedy

In the 1930s, the public began to take notice of the health problems suffered by employees who worked in dusty environments. The Great Depression was indirectly responsible for the attention given to an occupational disease that came to be known as *silicosis*. As the economic crash spread, business after business shut down and laid off its workers. Unemployed miners and foundry workers began to experience problems finding new jobs

1867	Massachusetts introduces factory inspection.
1868	Patent is awarded for first barrier safeguard.
1869	Pennsylvania passes law requiring two exits from all mines, and the Bureau of Labor Statistics is formed.
1877	Massachusetts passes law requiring safeguards on hazardous machines, and the Employer's Liability Law is passed.
1892	First recorded safety program is established.
1900	Frederick Taylor conducts first systematic studies of efficiency in manufacturing. Followed by the motion studies of Frank Gilbreth.
1907	Bureau of Mines is created by the U.S. Department of the Interior.
1908	Concept of workers' compensation is introduced in the United States.
1911	Wisconsin passes the first effective workers' compensation law in the United States, and New Jersey becomes the first state to uphold a workers' compensation law.
1912	First Cooperative Safety Congress meets in Milwaukee.
1913	National Council of Industrial Safety is formed.
1915	National Council of Industrial Safety changes its name to National Safety Council.
1916	Concept of negligent manufacture is established (product liability).
1924	Hawthorne Light Experiments.
1936	National Silicosis Conference convened by the U.S. Secretary of Labor.
1970	Occupational Safety and Health Act passes.
1977	Federal Mine Safety Act passes.
1978	OSHA offers education and training grants.
1980	OSHA coverage extended to federal employees.
1986	Superfund Amendments and Reauthorization Act pass.
1990	Amended Clean Air Act of 1970 passes. Also, safety professionals begin to apply the principles of ergonomics.
1996	Total safety management (TSM) concept is introduced.
2000	U.S. firms begin to pursue ISO 14000 registration for environmental safety management.
2003	Workplace violence and terrorism are an ongoing concern of safety and health professionals.
2007	Safety of older people reentering the workplace becomes an issue.
2009	Global Harmonization System for chemicals established.
2010	Off-the-job safety becomes an issue.
2017	Pressure on foreign companies that produce goods sold in the United States to improve their safety standards.

FIGURE 1-1 Milestones in the safety movement.

when physical examinations revealed that they had lung damage from breathing silica. Cautious insurance companies recommended preemployment physicals as a way to prevent future claims based on preexisting conditions. Applicants with silica-damaged lungs were refused employment. Many of them sued. This marked the beginning of industry-wide interest in what would eventually be called the “king” of occupational diseases.

Lawsuits and insurance claims generated public interest in silicosis, but it was the Hawk's Nest tragedy that solidified public opinion in favor of protecting workers from this debilitating disease.¹² A company was given a contract to drill a passageway through a mountain located in the Hawk's Nest region of West Virginia (near the city of Gauley Bridge). Workers spent as many as 10 hours per day breathing the dust created by drilling

and blasting. It turned out that this particular mountain had an unusually high silica content. Silicosis is a disease that normally takes 10 to 30 years to show up in exposed workers. At Hawk's Nest, workers began dying in as little time as a year. By the time the project was completed, hundreds had died. To make matters even worse, the company often buried an employee who died from exposure to silica in a nearby field without notifying the family. Those who enquired were told that their loved one left without saying where he was going.

A fictitious account of the Gauley Bridge disaster titled *Hawk's Nest*, by Hubert Skidmore, whipped the public outcry into a frenzy, forcing Congress to respond.

This tragedy and the public outcry that resulted from it led a group of companies to form the Air Hygiene Foundation to conduct research and develop standards for working in dusty environments. Soon thereafter, the U.S. Department of Labor provided the leadership necessary to make silicosis a compensable disease under workers' compensation in most states. Today, dust-producing industries use a wide variety of administrative controls, engineering controls, and personal protective equipment to protect workers in dusty environments. However, silicosis is still a problem. Approximately 1 million workers in the United States are still exposed to silica every year, and 250 people die annually from silicosis.

Asbestos Menace

Asbestos was once considered a "miracle" fiber, but in 1964, Dr. Irving J. Selikoff told 400 scientists at a conference on the biological effects of asbestos that this widely used material was killing workers. This conference changed how Americans viewed not just asbestos, but also workplace hazards in general. Selikoff was the first to link asbestos to lung cancer and respiratory diseases.¹³

At the time of Selikoff's findings, asbestos was one of the most widely used materials in the United States. It was found in homes, schools, offices, factories, and ships, and even in the filters of cigarettes. Selikoff continued to study the effects of asbestos exposure from 1967 to 1986. During this time, he studied the mortality rate of 17,800 workers who had been exposed to asbestos. He found asbestos-related cancer in the lungs, gastrointestinal tract, larynx, pharynx, kidneys, pancreas, gall bladder, and bile ducts of workers.

Finally, in the 1970s and 1980s, asbestos became a controlled material. Regulations governing the use of asbestos were developed, and standards for exposure were established. Asbestos-related lawsuits eventually changed how industry dealt with this tragic material. In the 1960s, industry covered up or denied the truth about asbestos. Now, there is an industry-wide effort to protect workers who must remove asbestos from old buildings and ships during remodeling, renovation, or demolition projects.

Bhopal Tragedy

On the morning of December 3, 1984, over 40 tons of methyl isocyanate and other lethal gases, including hydrogen cyanide, leaked into the northern end of Bhopal, killing more than 3,000 people in its aftermath.¹⁴ After the accident, it was discovered that the protective equipment that could have halted the impending disaster was not in full working order. The refrigeration system that should have cooled the storage tank was shut down, the scrubbing system that should have absorbed the vapor was not immediately available, and the flare system that would have burned any vapor that got past the scrubbing system was out of order.¹⁵

The International Medical Commission visited Bhopal to assess the situation and found that as many as 50,000 other people had been exposed to the poisonous gas and may still suffer disability as a result. This disaster shocked the world. Union Carbide Corporation, the owner of the chemical plant in Bhopal, India, where the incident occurred, was accused of many things, including the following:

- **Criminal negligence.**
- **Corporate prejudice.** Choosing poverty-stricken Bhopal, India, as the location for a hazardous chemical plant on the assumption that few would care if something went wrong.
- **Avoidance.** Putting its chemical plant in Bhopal, India, to avoid the stricter safety and health standards of the United States and the Occupational Safety and Health Administration (OSHA) in particular.

In February 1989, India's Supreme Court ordered Union Carbide India Ltd. to pay \$470 million in compensatory damages. The funds were paid to the Indian government to be used to compensate the victims. This disaster provided the impetus for the passage of stricter safety legislation worldwide. In the United States, it led to the passage of the Emergency Planning and Community Right-to-Know Act of 1986.

Factory Fire in Bangladesh

In November 2012, a garment factory fire in Bangladesh killed 112 employees. The magnitude of the tragedy was enhanced when it was discovered that the factory produced garments to sell in several major retail outlets in the United States. Fire inspectors suspect that an electrical short circuit caused the blaze, which spread quickly because of the flammable nature of material used to produce T-shirts in the factory. There were complaints that well-known retailers in the United States, and elsewhere in the Western world, were partially culpable in the tragedy because there was evidence that they knew of the unsafe conditions beforehand.

The garment factory in question had a functioning fire alarm and the alarm did go off properly. Unfortunately, supervisors demanded that workers go back to their sewing machines and even blocked an exit door workers could have used to escape the conflagration. It was learned in the subsequent investigation that the factory's fire extinguishers did not work and were displayed only to fool inspectors. A follow-up investigation revealed that 100 workers had been burned to death inside the factory while another 12 jumped to their deaths to escape the flames. This tragedy added to the mounting pressure for U.S. companies that contract with offshore manufacturers to pressure those manufacturers to implement safe and healthy work practices.

ROLE OF ORGANIZED LABOR

Organized labor has played a crucial role in the development of the safety movement in the United States. From the outset of the Industrial Revolution in this country, organized labor has fought for safer working conditions and appropriate compensation for workers injured on the job. Many of the earliest developments in the safety movement were the result of long and hard-fought battles by organized labor.

Although the role of unions in promoting safety is generally acknowledged, one school of thought takes the opposite view. Proponents of this dissenting view hold that union involvement actually slowed the development of the safety movement. Their theory is that unions allowed their demands for safer working conditions to become entangled with their demands for better wages; as a result, they met with resistance from management. Regardless of the point of view, there is no question that working conditions in the earliest years of the safety movement were often reflective of an insensitivity to safety concerns on the part of management.

Among the most important contributions of organized labor to the safety movement was their work to overturn antilabor laws relating to safety in the workplace. These laws were the fellow servant rule, the statutes defining contributory negligence, and the concept of assumption of risk.¹⁶ The **fellow servant rule** held that employers were not liable for workplace injuries that resulted from the negligence of other employees. For example, if worker X slipped and fell, breaking his back in the process, because worker Y spilled oil on the floor and left it there, the employer's liability was removed. In addition, if the actions of employees contributed to their own injuries, the employer was absolved of any liability. This was the doctrine of **contributory negligence**. The concept of **assumption of risk** was based on the theory that people who accept a job assume the risks that go with it. It says employees who work voluntarily should accept the consequences of their actions on the job rather than blame the employer.

Because the overwhelming majority of industrial accidents involve negligence on the part of one or more workers, employers had little to worry about. Therefore, they had little incentive to promote a safe work environment. Organized labor played a crucial role in bringing deplorable working conditions to the attention of the general public. Public

awareness and, in some cases, outrage eventually led to these **employer-biased laws** being overturned in all states except one. In New Hampshire, the fellow servant rule still applies.

West Fertilizer Company Explosion

On April 17, 2013, an explosion occurred at the storage and distribution center of the West Fertilizer Company in West, Texas. The explosion occurred when fire set off ammonium nitrate while emergency personnel were battling the blaze. The explosion killed 15 people and injured 160 others. More than 150 surrounding buildings were damaged or destroyed. In the ensuing investigation, it was determined that the fire had been deliberately set. Prior to the fire and explosion, OSHA had fined the company for improper storage of anhydrous ammonia and cited the company for violating its respiratory protection standards. The company had also been fined by the Environmental Protection Agency (EPA) in 2006 for failing to file a risk management program plan in a timely manner. Further, the company had been fined in 2012 by the U.S. Department of Transportation for violations pertaining to the improper storage of anhydrous ammonia.

ROLE OF SPECIFIC HEALTH PROBLEMS

Specific health problems that have been tied to workplace hazards have played significant roles in the development of the modern safety and health movement. These health problems contributed to public awareness of dangerous and unhealthy working conditions that, in turn, led to legislation, regulations, better work procedures, and better working conditions.

Lung disease in coal miners was a major problem in the 1800s, particularly in Great Britain, where much of the Western world's coal was mined at the time. Frequent contact with coal dust led to a widespread outbreak of anthracosis among Great Britain's coal miners. Also known as the *black spit*, this disease persisted from the early 1800s, when it was first identified, until around 1875, when it was finally eliminated by such safety and health measures as ventilation and decreased work hours.

In the 1930s, Great Britain saw a resurgence of lung problems among coal miners. By the early 1940s, British scientists were using the term *coal-miner's pneumoconiosis*, or CWP, to describe a disease from which many miners suffered. Great Britain designated CWP a separate and compensable disease in 1943. However, the United States did not immediately follow suit, even though numerous outbreaks of the disease had occurred among miners in this country.

The issue was debated in the United States until Congress finally passed the Coal Mine Health and Safety Act in 1969. The events that led up to the passage of this act were tragic. An explosion in a coal mine in West Virginia in 1968 killed 78 miners. This tragedy focused attention on mining health and safety, and Congress responded by passing the Coal Mine Health and Safety Act. The act was amended in 1977 and again in 1978 to broaden the scope of its coverage.

Over the years, the diseases suffered by miners were typically lung diseases caused by the inhalation of coal dust particulates. However, health problems were not limited to

Discussion Case

What Is Your Opinion?

Two safety and health students are debating the issue of corporate responsibility. Tom thinks that industry has clearly demonstrated its unwillingness over the years to provide a safe and healthy work environment for employees. He offers such examples as the Gauley Bridge disaster and the Bhopal gas tragedy as evidence. Janet agrees that industry indeed has a checkered past on safety and health, but she thinks employers have learned that their workforce is a valuable asset that should be protected. Tom's response is, "Take away federal and state mandates, and industry would return to its old ways in less than a year." Join this debate. What is your opinion?

coal miners. Other types of miners developed a variety of diseases, the most common of which was silicosis. Once again, it took a tragic event—the Gauley Bridge disaster, discussed earlier—to focus attention on a serious workplace problem.

Congress held a series of hearings on the matter in 1936. That same year, representatives from business, industry, and government attended the National Silicosis Conference, convened by the U.S. secretary of labor. Among other outcomes of this conference was a finding that silica dust particulates did, in fact, cause silicosis.

Mercury poisoning is another health problem that has contributed to the evolution of the safety and health movement by focusing public attention on unsafe conditions in the workplace. The disease was first noticed among the citizens of a Japanese fishing village in the early 1930s. A disease with severe symptoms was common in Minamata, but extremely rare throughout the rest of Japan. After much investigation into the situation, it was determined that a nearby chemical plant periodically dumped methyl mercury into the bay that was the village's primary source of food. Consequently, the citizens of this small village ingested hazardous dosages of mercury every time they ate fish from the bay.

Mercury poisoning became an issue in the United States after a study was conducted in the early 1940s that focused on New York City's hat-making industry. During that time, many workers in this industry displayed the same types of symptoms as the citizens of Minamata, Japan. Because mercury nitrate was used in the production of hats, enough suspicion was aroused to warrant a study. The study linked the symptoms of workers with the use of mercury nitrate. As a result, the use of this hazardous chemical in the hat-making industry was stopped, and a suitable substitute—hydrogen peroxide—was found.

As discussed earlier, asbestos was another important substance in the evolution of the modern safety and health movement. By the time it was determined that asbestos is a hazardous material, the fibers of which can cause asbestosis or lung cancer (mesothelioma), thousands of buildings contained the substance. As these buildings began to age, the asbestos—particularly that used to insulate pipes—began to break down. As asbestos breaks down, it releases dangerous microscopic fibers into the air. These fibers are so hazardous that removing asbestos from old buildings has become a highly specialized task requiring special equipment and training.

More recently, concern over the potential effects of blood-borne pathogens in the workplace has had a significant impact on the safety and health movement. Diseases such as acquired immunodeficiency syndrome (AIDS) and pathogens such as human immunodeficiency virus (HIV) and Hepatitis B (HBV) have caused changes to how safety and health professionals respond to medical emergencies and injuries in which blood and other bodily fluids may be present. Concern over the potential effects of blood-borne pathogens has introduced a whole new set of precautions as well as fears—some rational and some irrational—into the realm of workplace safety. Chapter 24 is devoted to the concept of blood-borne pathogens as it relates to workplace safety.

SAFETY AND HEALTH STANDARDS APPLY TO MORE THAN JUST MANUFACTURING

There is a misconception in some quarters that safety and health procedures such as those presented in this book apply only to manufacturing. While it is important for employers in the manufacturing sector to provide a safety and healthy work environment for their personnel, it is equally important for employers in all work sectors to do the same. The safe and healthy work practices advocated in this book apply to all work sectors including natural resources and mining, manufacturing, construction, services, trade, transportation, utilities, information, financial, professional and business, education, government, healthcare, maritime, leisure, retail, and hospitality. As you will learn in Chapter 6, certain industry sectors such as construction and maritime have their own specific safety and health standards. But other sectors are covered by the rules set forth in 29 CFR 1910, OSHA's General Industry Standard.

DEVELOPMENT OF ACCIDENT PREVENTION PROGRAMS

In the modern workplace, there are many different types of **accident prevention** programs ranging from the simple to the complex. Widely used accident prevention techniques include failure minimization, fail-safe designs, isolation, lockouts, screening, personal protective equipment, redundancy, timed replacements, and many others. These techniques are individual components of broader safety programs. Such programs have evolved since the late 1800s.

In the early 1800s, employers had little concern for the safety of workers and little incentive to be concerned. Consequently, organized safety programs were nonexistent, a situation that continued for many years. However, between World War I and World War II, industry discovered the connection between quality and safety. Then, during World War II, troop call-ups and deployments created severe labor shortages. Faced with these shortages, employers could not afford to lose workers to accidents or for any other reason. This realization created a greater openness toward giving safety the serious consideration that it deserved. For example, according to the Society of Manufacturing Engineers (SME), around this time industry began to realize the following:

- Improved engineering could prevent accidents.
- Employees were willing to learn and accept safety rules.
- Safety rules could be established and enforced.
- Financial savings from safety improvement could be reaped by savings in compensation and medical bills.¹⁷

With these realizations came the long-needed incentive for employers to begin playing an active role in creating and maintaining a safe workplace. This, in turn, led to the development of organized safety programs sponsored by management. Early safety programs were based on the **three Es of safety**: engineering, education, and enforcement (see Figure 1–2). The engineering aspects of a safety program involve making design improvements to both product and process. By altering the design of a product, the processes used to manufacture it can be simplified and, as a result, made less dangerous. In addition, the manufacturing processes for products can be engineered in ways that decrease potential hazards associated with the processes.

The education aspect of a safety program ensures that employees know how to work safely, why it is important to do so, and that safety is expected by management. Safety education typically covers the what, when, where, why, and how of safety.

The enforcement aspect of a safety program involves making sure that employees abide by safety policies, rules, regulations, practices, and procedures. Supervisors and fellow employees play a key role in the enforcement aspects of modern safety programs.

DEVELOPMENT OF SAFETY ORGANIZATIONS

Today, numerous organizations are devoted in full, or at least in part, to the promotion of safety and health in the workplace. Figure 1–3 lists organizations with workplace safety as part of their missions. Figure 1–4 lists several governmental agencies and two related orga-

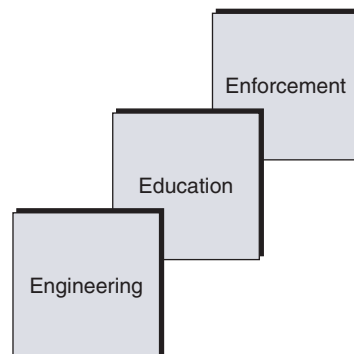


FIGURE 1–2 Three Es of safety.

nizations concerned with safety and health. These lists are extensive now, but this has not always been the case. Safety organizations in this country had humble beginnings.

The grandfather of them all is the NSC. The SME traces the genesis of this organization as follows:

The Association of Iron and Steel Electrical Engineers was organized in the first decade of the twentieth century and devoted much attention to safety problems in its industry. In 1911, a request came from this association to call a national industrial safety conference. The first Cooperative Safety Congress met in Milwaukee in 1912. A year later, at a meeting in New York City, the National Council of Industrial Safety was formed. It began operation in a small office in Chicago. At its meeting in 1915, the organization's name was changed to the National Safety Council (NSC).¹⁸

Alliance for American Insurers
 American Board of Industrial Hygiene
 American Conference of Government Industrial Hygienists
 American Industrial Hygiene Association
 American Insurance Association
 American National Standards Institute
 American Occupational Medical Association
 American Society for Testing and Materials
 American Society of Mechanical Engineers
 American Society of Safety Engineers
 Chemical Transportation Emergency Center
 Human Factors Society
 National Fire Protection Association
 National Safety Council
 National Safety Management Society
 Society of Automotive Engineers
 System Safety Society
 Underwriters Laboratories Inc.

FIGURE 1-3 Organizations concerned with workplace safety.

American Public Health Association*
 Bureau of Labor Statistics
 Bureau of National Affairs
 Commerce Clearing House*
 Environmental Protection Agency
 National Institute for Standards and Technology (formerly National Bureau of Standards)
 National Institute for Occupational Safety and Health
 Occupational Safety and Health Administration
 Superintendent of Documents, U.S. Government Printing Office
 U.S. Consumer Product Safety Commission
 *Not a government agency.

FIGURE 1-4 Government agencies and other organizations concerned with workplace safety.

Today, the NSC is the largest organization in the United States devoted solely to safety and health practices and procedures. Its purpose is to prevent the losses, both direct and indirect, arising out of accidents or from exposure to unhealthy environments. Although it is chartered by an act of Congress, the NSC is a nongovernmental, not-for-profit, public service organization.

The **Occupational Safety and Health Administration (OSHA)** is the government's administrative arm for the OSH Act. Formed in 1970, OSHA sets and revokes safety and health standards, conducts inspections, investigates problems, issues citations, assesses penalties, petitions the courts to take appropriate action against unsafe employers, provides safety training, provides injury prevention consultation, and maintains a database of health and safety statistics.

Another governmental organization is the **National Institute for Occupational Safety and Health (NIOSH)**. This organization is part of the Centers for Disease Control and Prevention (CDC) of the Department of Health and Human Services. NIOSH is required to publish annually a comprehensive list of all known toxic substances. NIOSH will also provide on-site tests of potentially toxic substances so that companies know what they are handling and what precautions to take.

An organization of note is the **Chemical Safety Board (CSB)**. The CSB is a federal agency charged with the responsibility to investigate industrial chemical accidents. The CSB conducts root cause analyses of chemical accidents that occur at fixed-site facilities (as opposed to accidents involving chemical that are being transported). The agency does not issue fines or citations, but does make recommendations to OSHA and the EPA. CSB is independent of these and other regulatory agencies, so its investigations can be used to measure the effectiveness of regulations relating to chemical safety.

SAFETY AND HEALTH MOVEMENT TODAY

The safety and health movement has come a long way since the Industrial Revolution. Today, there is widespread understanding of the importance of providing a safe and healthy workplace. The tone was set during and after World War II when all the various practitioners of occupational health and safety began to see the need for cooperative efforts. These practitioners included safety engineers, safety managers, industrial hygienists, occupational health nurses, and physicians. Integration has led to better sharing of knowledge among these practitioners concerning about safety and health problems in the workplace, brought a greater level of expertise to bear on evaluating the causes of safety and health problems, generated a large and growing database of helpful information about safety and health problems, enhanced the focus on accident prevention, and encouraged employers to make safety and health a high priority.

INTEGRATED APPROACH TO SAFETY AND HEALTH

The integrated approach has become the norm that typifies the safety and health movement of today. By working together and drawing on their own respective areas of expertise, safety and health professionals are better able to identify, predict, control, and correct safety and health problems.

Safety Fact

Safety Movement and War

World War II actually had a positive effect on the modern safety and health movement. During the war, there was a shortage of able-bodied, skilled workers in factories supporting the war effort because most of these workers were in the armed services. Consequently, preserving the safety and health of the relatively few skilled workers still available was paramount. The law of supply and demand suddenly made workplace safety a significant issue, which it still is today. The military war is over, but the economic war still rages. To be competitive in this international conflict, employers today must follow the lead of their predecessors during World War II and protect their employees.

OSHA reinforces the integrated approach by requiring companies to have a plan for doing at least the following: (1) providing appropriate medical treatment for injured or ill workers, (2) regularly examining workers who are exposed to toxic substances, and (3) having a qualified first-aid person available during all working hours.

Smaller companies may contract out the fulfillment of these requirements. Larger companies often maintain a staff of safety and health professionals. The safety and health staff of a modern company can now include such positions as safety engineer, safety manager, ergonomist, industrial hygiene professionals, radiation control specialists, occupational nurses, physicians, psychologists, counselors, educators, and dieticians.

NEW MATERIALS, NEW PROCESSES, AND NEW PROBLEMS

The job of the safety and health professional is more complex than it has ever been. The materials out of which products are made have become increasingly complex and exotic. Engineering metals now include carbon steels, alloy steels, high-strength low-alloy steels, stainless steels, managing steels, cast steels, cast irons, tungsten, molybdenum, titanium, aluminum, copper, magnesium, lead, tin, zinc, and powdered metals. Each of these metals requires its own specialized processes.

Nonmetals are more numerous and have also become more complex. Plastics, plastic alloys and blends, advanced composites, fibrous materials, elastomers, and ceramics also bring their own potential hazards to the workplace.

In addition to the more complex materials being used in modern industry and the new safety and health concerns associated with them, modern industrial processes are also becoming more complex. As these processes become automated, the potential hazards associated with them often increase. Computers; lasers; industrial robots; nontraditional processes such as explosive welding, photochemical machining, laser beam machining, ultrasonic machining, and chemical milling; automated material handling; water-jet cutting expert systems; flexible manufacturing cells; and computer-integrated manufacturing have all introduced new safety and health problems in the workplace and new challenges for the safety and health professional.

Chapter 23 is devoted to coverage of the special safety and health problems associated with computers, robots, and automation. In addition, coverage of specific aspects of these problems is provided in different chapters throughout this book.

RAPID GROWTH IN THE PROFESSION

The complexities of the modern workplace have made safety and health a growing profession. Associate and baccalaureate degree programs in industrial technology typically include industrial safety courses. Some engineering degree programs have safety and health tracks. Several colleges and universities offer full degrees in occupational safety and health.

The inevitable result of the increased attention given to safety and health is that more large companies are employing safety and health professionals and more small companies are assigning these duties to existing employees. This is a trend that is likely to continue as employers see their responsibilities for safety and health spread beyond the workplace to the environment, the community, the users of their products, and the recipients of their by-products and waste.

DOES MOVING MANUFACTURING JOBS OVERSEAS REDUCE THE ACCIDENT RATE?

If you would like to start a debate among occupational safety and health professionals, ask this question: Is moving manufacturing jobs overseas reducing the accident rate in America? Some say “yes” and others say “no.” Here are some facts:

- Over the past decade, thousands of jobs in the manufacturing sector have migrated to China, India, Malaysia, Pakistan, and other countries that maintain low labor rates.

- Since 2003, the recordable injury and illness rate has declined in the United States every year.
- The largest year-to-year declines have been in the manufacturing sector. However, even the construction industry has seen declines during the same time period and those jobs are not being exported.

Some claim that the workplace accident rate is declining because America has *exported* its accidents along with its jobs, particularly in the manufacturing sector. Others claim that the declines can be attributed to more and better safety and health regulations, oversight, education, and enforcement. The more likely scenario is that both the loss of manufacturing jobs to foreign countries and better safety and health practices have contributed to the decline.

SUMMARY

1. Safety and health awareness has a long history. There is evidence of occupational safety and health efforts as far back as the time of the Egyptian pharaohs. The Code of Hammurabi, circa 2000 BC, contained clauses that could be interpreted as early attempts at workers' compensation. There is also evidence of concern for safety and health during the time of the Romans.
2. Organized labor has played a crucial role in the development of the safety movement in the United States. Particularly important was the work of unions to overturn antilabor laws inhibiting safety in the workplace.
3. Specific health problems associated with the workplace have contributed to the development of the modern safety and health movement. These problems include lung diseases in miners, mercury poisoning, and lung cancer tied to asbestos.
4. Tragedies have changed the face of the safety movement at different times in the United States. The Hawk's Nest tragedy, asbestos menace, **Triangle Shirtwaist Fire**, West Fertilizer Company Explosion, and Bhopal disaster are examples of such tragedies.
5. Widely used accident prevention techniques include failure minimization, fail-safe designs, isolation, lockouts, screening, personal protective equipment, redundancy, and timed replacements.
6. The development of the safety movement in the United States has been helped by the parallel development of safety organizations. Prominent among these are the National Safety Council, the National Safety Management Society, the American Society of Safety Engineers, and the American Industrial Hygiene Association.
7. The safety and health movement today is characterized by professionalization and integration. The safety and health team of a large company may include an industrial chemist or engineer, radiation control specialist, safety engineer or manager, occupational nurse, counselor, psychologist, and dietitian. New materials and processes are introducing new safety and health problems, making the integrated approach a practical necessity and promoting growth in the profession.

KEY TERMS AND CONCEPTS

Accident prevention	Fellow servant rule
Asbestos menace	Hawk's Nest tragedy
Assumption of risk	Inanimate power
Bhopal tragedy	National Council of Industrial Safety
Chemical Safety Board (CSB)	National Institute for Occupational Safety and Health (NIOSH)
Code of Hammurabi	Occupational Safety and Health Act (OSH Act)
Contributory negligence	Occupational Safety and Health Administration (OSHA)
Cooperative Safety Congress (CSC)	
Employer-biased laws	
Employer liability	

Organized labor	Triangle Shirtwaist Fire
Safety movement	West Fertilizer Company Explosion
Three Es of safety	Workers' compensation

REVIEW QUESTIONS

1. To what cause(s) can the improvements in workplace safety made to date be attributed?
2. Explain the significance of the Code of Hammurabi in terms of the safety movement.
3. Describe the circumstances that led to the development of the first organized safety program.
4. What is Frederick Taylor's connection to the safety movement?
5. Explain the development of the National Safety Council.
6. What impact did labor shortages in World War II have on the safety movement?
7. Explain how workplace tragedies have affected the safety movement. Give examples.
8. Explain the primary reasons behind the passage of the OSH Act.
9. Summarize briefly the role that organized labor has played in the advancement of the safety movement.
10. Define the following terms: *fellow servant rule*, *contributory negligence*, and *assumption of risk*.
11. Explain the three Es of safety.
12. Explain the term *integration* as it relates to modern safety and health.

ENDNOTES

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