FUNDAMENTALS OF OCCUPATIONAL SAFETY AND HEALTH

MARK A. FRIEND | JAMES P. KOHN

SEVENTH EDITION

Fundamentals of Occupational Safety and Health

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To the Eternal Memory of

James P. Kohn

Colleague, Teacher, Father, Husband, Friend

His legacy is not only the decades of service he gave to the safety and health profession, the many current and future safety professionals who have and will benefit from his work, and the workers whose lives and health he has helped protect, but the many hearts he touched.

Summary of Contents

Contents

Figures and Tables

Preface

The first edition of this book was written as a response to the need for a comprehensive, introductory-level text covering the major facets of occupational safety and health. The seventh edition of this book was written with the same objectives as previous editions:

- It should be easily comprehensible by those who lack experience or prior exposure to concepts in occupational safety and health, industrial hygiene, or occupational medicine.
- It should be on a writing level easily understood by a majority of the population, and yet be useful as a text for college courses.
- It should cover the major topics of concern to safety and health professionals and students to provide both with a philosophical base.

The seventh edition incorporates material from the earlier editions and contains necessary updates.

Dr. Burton Ogle, CSP, CIH, and Dr. Tracy Zontek, PhD, CIH, CSP, of Western Carolina University, have rewritten the chapter on industrial hygiene and updated the chapter on hazardous materials. Dr. Celeste Winterberger of Research Triangle Park in North Carolina was a significant contributor to the first edition and her legacy continues in this one. Dr. Scotty Dunlap, CSP, of Eastern Kentucky University, updated the chapter on transportation safety, while Dr. Randell Barry updated the chapter on extreme weather, and Brett Carruthers updated the chapter on workplace

violence. The rest of the chapters have material added as needed. As the title implies, *Fundamentals of Occupational Safety and Health* covers the basics for the professional's need to understand before accepting responsibility for promoting an environment conducive to reducing hazards and protecting lives. Unlike books exploring only the engineering aspects of the subject, this text attempts to balance the management of safety with the relevant science and the practical aspects of regulatory compliance.

This edition was revised without the assistance of *Dr. James P. Kohn*, who passed away in 1999. He was a friend, a professional, and an innovator in the fields of safety and safety education. All who knew him miss his comradeship and willingness to share knowledge and enthusiasm.

Special thanks go to my wife Kathy for all of her help and inspiration. She is a true friend.

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Chapter 2	Tom Wagner, Craig MacMurry, Sam Christy, Kelly Nelson, and Wes Heinold
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Chapter 17	Scotty Dunlap (who authored this chapter)
Chapter 18	Randell J. Barry, PhD (who authored this chapter)
Chapter 19	Robert Getchell, Keith McCullough, Mike Ban Derven, and Neil Brown
Appendix A	Eddie Anderson, Mike Baker, Barbara Dail, Craig Fulcher, Doug Gaylord, Barry Maxwell, David McDaniel, and Ron Skinner
Appendix B	Mike Baker, Craig Fulcher, Doug Gaylord, Darla Hinnant, David McDaniel, Glory Mizzelle, Ron Skinner, Ward Taylor, Chip Tillett, and Jason Whichard

In addition, the authors want to recognize Kathy Friend, MSOS, and Carrie Kohn, MA, for their professional encouragement.

1

Introduction to Occupational Safety and Health

CHAPTER OBJECTIVES

After completing this chapter, you will be able to

- Explain the importance of occupational safety and health
- Identify key historical figures that have contributed to the profession
- Define basic terminology used in occupational safety and health
- List job titles of individuals performing occupational safety and health activities
- Identify roles and responsibilities of safety and health professionals
- Identify basic guideposts for judging ethical behaviors

CASE STUDY

As a 22-year-old construction worker with 11 months of experience on the job, Bob had finally made it. Since graduating high school, Bob had tried a lot of things, but they just never seemed right for him. He attended a community college for one year and then dropped out. There was too much theory that didn't relate to how he saw the world. Bob tried a number of jobs, but minimum-wage salaries forced him to live at home with his parents. His parents were good people, but he was ready to move on with his life. With this new job, everything was turning out great. Bob was

bringing home a good paycheck. He had just moved into a new apartment, which he shared with his high school buddy Tim, and he was going the next day to sign the papers for a brand-new pickup truck.

Bob never made it to the dealership to sign those papers. Maybe he was distracted thinking about that "killer" pickup that he was about to purchase. Perhaps he never realized how dangerous it actually was to work on that scaffolding. After all, it was only 20 feet off the ground and it looked safe. Bob had worked on wet scaffolding before, and although it was wet from the rains the previous night, nothing had ever happened to make him concerned about working at those heights. Bob's world changed when he fell to the ground. His fall put him in a wheelchair, paralyzed from the waist down.

OCCUPATIONAL SAFETY AND HEALTH

The field of occupational safety and health is concerned with minimizing loss by aiding in the preservation and protection of both human and other physical assets in the workplace. The discipline is far-reaching in both scope and practice. It primarily involves *monitoring* the workplace and *advising* employers or management on the best ways to prevent and minimize losses. Final responsibility for action always rests on the shoulders of the management, as they are ultimately accountable for workplace behaviors. Management is held accountable by stockholders or owners of the company, the Occupational Safety and Health Administration (OSHA), the courts, and even public opinion. The job of the safety and health professional is to assist management by observing the workplace and providing guidance.

In practice, occupational safety and health addresses moral and economic issues—typically within a framework required by law. The United States government and governments worldwide require protection of employees from hazards that may result in injury, illness, or death. Under the Occupational Safety and Health Act of 1970, known as the OSHAct, employers in the United States are required to provide safe and healthy workplaces. The safety and health professionals help employers to do that.

Unfortunately, for some employers the responsibility to protect human life is not as important to them as other goals or priorities. A company may focus on productivity and profits to the exclusion of safety and

health. Its managers may view the occurrence of illnesses and injuries as a routine part of the job. In reality the amount of production required to cover costs associated with accidents in the workplace can be substantial and far outweigh the expense of providing a safe and healthy working environment. The role of the safety professional requires monitoring workplace conditions and advising management on the importance of making critical corrections for moral, legal, and economic reasons. The effective safety professional will work with the management team and help demonstrate to them that providing a safe and healthy working environment is the right thing to do for both the employees and the company. The safety and health professional must be able to make a convincing argument, based on sound business practices; otherwise, management may choose to allow safety and health to become low priorities. Neither can exist without management support, and that support is only forthcoming when profits can be made. The organization cannot exist without profit, and the job of the safety professional cannot exist without production. Safety does not and never will come first. Safety cannot and will not exist without profitable production, but profitable production is not likely to exist without safety. Safe and profitable production is the ultimate goal of the safety professional. This goal can only be accomplished with full support of management. Management ultimately oversees the safety function and makes final decisions regarding its implementation. The safety system is integrated into the overall management system. When an accident occurs, it is always considered a fault in the management system.

IMPORTANCE OF OCCUPATIONAL SAFETY AND HEALTH

Morally, legally, and economically, occupational safety and health have become important issues. Companies are attempting to remain profitable in an ever-more-competitive, global economy. Addressing safety, health, and environmental issues may mean more than good business practice. For many companies strong safety, health, and environmental programs may actually mean survival.

Thousands of employees are reportedly killed annually in the United States as a result of on-the-job incidents, and many more are injured. The costs associated with these losses are in the billions. Behind the numbers of deaths and injuries are real people—mothers, fathers, sisters, brothers,

spouses, sons, or daughters. They are people like Bob whose lives may never be the same again.

The Occupational Safety and Health Administration (OSHA) is the federal agency responsible for workplace safety and health; it attempts to address the safety and health concerns faced by American workers. OSHA may not only levy fines, but may also seek criminal prosecution of business owners and managers who willfully neglect the safety and health of their employees. In addition, employers may find themselves the target of civil suits levied by the victims and survivors of workplace accidents. Employers with poor safety and health records must also deal with rising medical insurance costs as well as unfavorable workers' compensation premiums. Unfortunately, many employers have not had to bear the full cost of injuring and killing members of their workforces. Workers, uninformed and unaware of their legal rights, have often shouldered the costs of the business not operating safely. The regulations and mechanisms for enforcement are in place in the United States, but the agencies charged with administering safety regulations are generally understaffed. With well over one hundred million workers at millions of worksites of covered employers and not even 2500 OSHA inspectors, the task is clearly a challenge for the agency. In addition, certain categories of workers, such as some federal, state, and municipal employees do their jobs without protection from OSHA or any government agency. Most federal employees are excluded from OSHA regulations. Many state and municipal employees in states covered by federal OSHA also work without OSHA protection. Continued reduction of accidents in the United States will require an increase in initiative on the parts of all parties involved to include employers, employees, and federal and state governments. An understanding of the issues of today will be enhanced by a review of the past.

EARLY HISTORICAL EXAMINATION OF OCCUPATIONAL SAFETY AND HEALTH

Ancient Greek and Roman Physicians

Concern for occupational safety and health is not a recent issue. Many of today's health and safety problems were first observed over 2000 years

ago. An early account is associated with the Code of Hammurabi that dates back to approximately 2100 BC. In an attempt to recompense victims, it primarily addressed personal injury and losses and prescribed a schedule of punishments and payments for wrongdoers.

Greek and Roman physicians, practicing between 400 BC and 300 AD, expressed concern for the health of individuals exposed to the metals commonly used during this period. These included Hippocrates, the Father of Medicine, and Pliny the Elder, a Roman physician and scientist, both discussed in chapter 6.

Galen, a Roman physician who lived during the second century, wrote about occupational diseases and the dangers of acid mists to copper miners. He was also concerned with the mining, tanning, and chemical occupations, noting several diseases contracted by individuals working in those professions.

The European Renaissance and the Industrial Revolution

Prior to the Renaissance, little information is available on European injury, illness, and property damage-prevention activities. Reports of medieval scribes suffering lead poisoning, while performing the common practice of tipping their quills with their tongues between dips into metallic ink solutions, were repeatedly noted before the fifteenth century. Unfortunately, little else was recorded regarding safety and health in that period. During the European Renaissance, physicians and chemists began noticing the relationship between occupational activities and worker health and safety.

Ulrich Ellenborg, for example, recognized, identified, and reported on "the poisonous and noxious vapors and fumes of metals." In 1437, he recognized that the vapors of some metals, including lead and mercury, were dangerous and described the symptoms of industrial poisoning from these sources. He also became aware of asbestos and lung diseases among miners.

Bernardo Ramazzini, an Italian physician, circa 1700 published *De morbis artificum diatriba* or *The Diseases of Workers*, the first treatise on occupational disease. Considered by some to be the Father of Occupational Medicine and others as the Father of Industrial Hygiene, he recommended physicians ask their patients, "What is your trade?" He

urged students to learn the nature of occupational diseases in shops, mills, mines, or wherever men toil.

In 1666, fire swept through London, England and raged for several days. At that time, London was a city of half-timbered, pitch-covered, medieval buildings that ignited at the touch of a spark. From an inn on Pudding Lane, the fire spread into Thames Street, where riverfront warehouses were bursting with oil, tallow, and other combustible goods. The customary recourse during a fire of such magnitude was to demolish every building in the path of the flames, in order to deprive the fire of fuel, but the city's mayor hesitated, fearing the high cost of rebuilding. With no building codes at the time, houses were frequently built to the edge of the street. Second and subsequent stories were often cantilevered with the top floors nearly touching houses across the street. The fire raged and destroyed a large part of London. Early examples of building and fire codes resulted from this disaster.

During the period between 1760 and 1840, history witnessed dramatic advances in technology. *Dr. Percival Pott* (circa 1775) identified the first form of cancer, scrotal cancer in chimney sweeps, and determined its relationship to soot and coal tar exposure. This observation resulted in numerous regulations called the Chimney Sweep Acts that were promulgated between 1788 and 1875. About the same time, several industrialists also became concerned with the welfare of their workers. *Sir Robert Peel*, a mill owner, made the English Parliament aware of the deplorable working conditions often existing in the mills. He reported that orphan labor was frequently used to perform demanding tasks in less than sanitary conditions. His study of these deplorable conditions revealed the mean life expectancy of the working class, under these terrible conditions, was only 22 years, while the mean age of the wealthier class was 44 years.

With advancing technology and the Industrial Revolution came an increase in safety and health hazards. The innovations of mechanical textile machinery, foundry furnaces, steam engines, and numerous other inventions created a new and more dangerous workplace environment. Factories and other workplaces were mazes of moving belts, pulleys, and gears. Human senses were assaulted with fumes, toxic vapors, noise, and heat. The health and safety problem was compounded by the introduction of increasing numbers of women and children into the workforce. Long

workdays, unsanitary conditions, and demanding physical labor amplified the likelihood of injury and illness for this new workforce.

At the dawn of the Industrial Revolution in England, *Charles Thackrah* became concerned with occupational safety and health and studied the effects of arts, trades, life habits, civic states, and professions upon health and longevity. By employing basic principles of occupational medicine, he became the first physician in the English-speaking world to establish the practice of industrial medicine. His writings also led to a raised public awareness of the plight of many of the new working class. In 1842, *Edwin Chadwick*, a British lawyer and sanitarian, described the deplorable conditions of factory workers in his "Report into the Sanitary Conditions of the Labouring Population of Great Britain." He stated that life expectancy was much lower in towns than in the countryside and attributed his findings to air pollution.

In the United States, the Industrial Revolution began in the early 19th century as factories and mills in New England sprang to life. In Lowell, Massachusetts, women and girls, as young as six to ten years of age, worked long hours, often from five in the morning until seven in the evening. Their work required their hands to be placed very close to the [in-running] gears of spinning machines. Many were injured or maimed in the moving gears and pulleys of the textile machinery. Their fingers were cut off or mangled with such frequency that machine-guarding laws were eventually passed. Fatalities in the mining and steel industries were as common as those in the textile industry. In 1877, Massachusetts passed a regulation requiring safeguards on hazardous machinery. This law also tied liability to the actions of employers.

Exposure to toxic metals, such as mercury and lead, has been an occupational health problem for hundreds of years. Technological advances introduced new and unique hazards, typically overlooked by untrained observers, and only recognized after numerous cases were reported. Dramatic changes in technology and workplace design, along with other advancements, have not necessarily resulted in healthier or safer workplaces. Employees today may be exposed to as many workplace hazards as were their ancestors in years past. Factory machinery with unguarded gears, mangling fingers and hands, has been replaced by electronic office equipment causing wrist and arm injuries. Many companies have addressed chemical and toxic hazards, but problems still occur, as evidenced

by the Verla International factory explosions and the Deepwater Horizon oil spill in the Gulf of Mexico. The complexity of current safety and health conditions mirrors the complexities associated with modern workplace technology. Practitioners in this profession must develop the broad range of knowledge and skills necessary to ensure the protection of people and company resources. This knowledge base must include a well-grounded understanding of the terms and concepts used in the profession. In addition, occupational safety and health professionals must possess the skills required to effectively perform their roles and responsibilities in safety, health, and the environmental arenas. The ability to effectively advise management on needed changes and provide a strong rationale for those changes may also require knowledge of accounting and sound business practices. Specialized knowledge may also be needed to address the hazards associated with work in specific industries or locations.

TERMS AND CONCEPTS IN THE SAFETY PROFESSION

Safety professionals are concerned with the preservation of people and company resources. They need the knowledge and skills often acquired through formal education and/or experience in the safety field. Many safety professionals are certified after successfully completing the requirements for the designations "Certified Safety Professional" (CSP), "Certified Industrial Hygienist" (CIH), or others related to occupational safety and health. In order to achieve these designations, safety professionals must have a number of years of experience in the field and undergo a rigorous examination process for each.

Safety professionals attempt to achieve their loss prevention goals through the systematic application of principles taken from a variety of disciplines to include engineering, education, psychology, physiology, industrial hygiene, health physics, business, and management. Safety professionals are concerned with the elimination or control of hazards that may result in injury, illness, and property damage. They will often use techniques referred to as ***loss prevention*** and ***loss control*** to accomplish that goal.

Loss prevention describes a program designed to identify and correct potential accident problems before they result in financial loss or injury.

Loss control, on the other hand, is a program designed to minimize incident-based, financial losses. An example of the difference between loss prevention and loss control can be seen in the various activities associated with a fire protection and prevention program.

In a fire prevention program, employees can be trained to inspect their areas and remove combustible materials like oily rags or cardboard. These inspection activities would be an example of loss prevention. A fire protection program, on the other hand, might include employee training in the use of fire extinguishers. Employees would then possess the skills necessary to fight a fire. The fire might ignite, but following training, employees would be prepared to extinguish it and thus minimize the damage. Fire extinguisher training is an example of a loss-control technique.

Loss prevention and loss control are important to the safety professional who attempts to recognize, evaluate, and control hazards in the workplace. This is part of the process referred to as "safety management." *Safety management* encompasses the responsibilities of planning, organizing, leading, and controlling activities necessary to achieve an organization's loss-prevention and loss-control goals. Continuing the fire example, the safety professional might wish to establish a safety management program to address this danger. Safety professionals determine the problems that exist at their facility. They then establish the details of the fire-training program with goals and objectives of what is to be accomplished (planning). Next, they determine the trainers and materials necessary to implement the program by establishing a schedule to ensure all activities are accomplished (organizing). Safety professionals must then ensure the required resources are available, and the people involved in this project coordinate their efforts when required (leading). Finally, the professionals monitor and evaluate the progress of the project (controlling). All of this is done with the endorsement and engagement of the management team. A more detailed examination of the management of the safety function will be presented in chapter 10.

One of the most important terms used in the safety and health profession is "safety." It is probably the most misinterpreted term by individuals outside of the safety profession. For the layperson, safety means not getting injured. ***"Safety,"*** to the professional, implies reference to the likelihood or risk that a loss event will occur. It can be defined as "operating within an acceptable or low probability of risk associated with conditions

or activities having the potential to cause harm to people, equipment, facilities or the enterprise." Although the goal of a company may be to eliminate all loss events and have zero losses in the workplace, this can only be done through the elimination of all activities and all work. Nearly any activity carries some level of risk, and exposure to that risk is inherent in engaging in the activity. The safety professional attempts to minimize the risk, but the law of large numbers dictates that exposure to enough risks enough times will eventually and necessarily lead to loss. The role of the safety professional is to minimize loss, but it must be recognized that, in general, losses cannot be completely eliminated.

Risk can be defined as the measure of the probability and severity of a loss event taking place. A ***hazard*** is a workplace condition or worker action that can or has the potential to result in injury, illness, property damage, or interruption of a process or an activity. As revealed in these definitions, determining occupational risk requires an examination of both the probability of occurrence of a hazard that may cause injury and/or property damage and the severity of the resulting injury or loss.

ALARP is a common term used relative to risk. It refers to "as low as reasonably practicable." Since risk cannot be eliminated, every effort is made to lower it to a reasonably practicable point. Another common, related term is ***ALARA***—"as low as reasonably achievable." The idea is essentially the same. Although risk cannot be eliminated, it can be reduced to a reasonable level. Generally, "reasonable" is determined based on cost benefit. The benefit of further lowering the risk must be greater than the cost. At some point, additional lowering of risk isn't worth the additional dollars or effort. A similar concept is the "marginal cost of perfection" (Henderson, 2011). Perfection or complete elimination of risk from any activity is not generally achievable without eliminating the activity altogether.

The evaluation of risks in the workplace starts with the identification of the types of hazards existing at the facility. Establishing a process to ensure hazards are identified is a primary goal of a progressive organization with a strong, safety-management program. The organization then works to eliminate or reduce the risks associated with those hazards to the lowest achievable and reasonable level. Nothing is risk free. Safety professionals identify the tasks and activities having the greatest inherent risk. They then attempt to systematically eliminate or reduce the level of risk as much as feasibly possible given time, personnel, and budget con-

straints. A detailed discussion about risk assessment will be presented in chapter 5, "Accident Causation Theory and Accident Investigation."

The control of risk ultimately leads to the reduction of losses. There are several different types of losses safety professionals attempt to eliminate or control, including worker-related health and safety losses—injuries, illnesses, and fatalities. Workplace losses can consist of damaged equipment, damaged raw materials or finished products, damaged or destroyed facilities, downtime, service/production interruption, or loss of reputation. Most of this loss occurs as a result of accidents.

While many consider accidents to be events occurring beyond an individual's control, safety professionals look at accidents in a more systematic and determined manner. ***Accidents*** are unplanned events, often resulting in injuries or damage that interrupt routine operations. They are nearly always preceded by unsafe acts of employees, hazardous conditions in the workplace, or both. When appropriate action is taken, *most* accidents can be eliminated.

JOB TITLES OF INDIVIDUALS PERFORMING OCCUPATIONAL SAFETY AND HEALTH ACTIVITIES

There are many titles given to individuals who perform occupational safety and health activities. The following list describes just a few of those titles:

Industrial Hygienist: Although basically trained in engineering, physics, chemistry, or biology, this individual has acquired, through study and experience, knowledge of the effects on health of chemical and physical agents under various levels of exposure. The industrial hygienist is involved in the monitoring and analytical methods required to detect the extent of exposure and the engineering and other methods used for hazard control.

Risk Manager: The risk manager in an organization is typically responsible for insurance programs and other activities that minimize losses resulting from fire, accidents, and other natural and man-made losses.

Safety Professional: An individual who, by virtue of specialized knowledge and skill and/or educational accomplishments, has

achieved professional status in the safety field. This individual may also have earned the status of Certified Safety Professional (CSP) from the Board of Certified Safety Professionals (BSCP).

Safety Engineer: An individual who, through education, licensing, and/or experience, devotes most or all of employment time to the application of scientific principles and methods for the control and modification of the workplace and other environments to achieve optimum protection for both people and property.

Safety Manager: The individual responsible for establishing and maintaining the safety organization and its activities in an enterprise. Typically, the safety manager administers the safety program and manages subordinates, including the fire prevention coordinator, industrial hygienist, safety specialists and security personnel.

THE SAFETY AND HEALTH PROFESSIONAL'S ROLE AND RESPONSIBILITY

The specific roles and responsibilities of safety professionals depend upon the jobs in which they are employed or the types of hazards present where they work. Kohn, Timmons, and Besesi (1991) examined the roles and responsibilities of safety professionals and identified the following activities as those most frequently performed:

Accident Investigation: determining the facts and causes related to an accident based on witness interviews and site inspections.

Work with Emergency Response Teams: organizing, training, and coordinating skilled employees to react to emergencies such as fires, accidents, or other disasters.

Environmental Protection: recognizing, evaluating, and controlling hazards that can lead to undesirable releases of harmful substances into air, water, or the soil.

Ergonomic Analysis and Modification: designing or modifying the workplace based on an understanding of human physiological/psychological characteristics, abilities, and limitations.

Fire Protection: eliminating or minimizing fire hazards by inspection, layout of facilities and design of fire suppression systems.

Scope and Functions of the Professional Safety Position

American Society of Safety Engineers

To perform their professional functions, safety professionals must have education, training and experience in a common body of knowledge. Safety professionals need to have a fundamental knowledge of physics, chemistry, biology, physiology, statistics, mathematics, computer science, engineering mechanics, industrial processes, business, communication, and psychology. Professional safety studies include industrial hygiene and toxicology; design of engineering hazard controls; fire protection; ergonomics; system and process safety; safety and health program management; accident investigation and analysis; product safety; construction safety; education and training methods; measurement of safety performance; human behavior; environmental safety and health; and safety, health, and environmental laws, regulations, and standards. Many safety professionals have backgrounds or advanced study in other disciplines, such as management and business administration, engineering, education, physical and social sciences, and other fields. Others have advanced study in safety. This extends their expertise beyond the basics of the safety profession.

Because safety is an element in all human endeavors, safety professionals perform their functions in a variety of contexts in both public and private sectors, often employing specialized knowledge and skills. Typical settings are manufacturing, insurance, risk management, government, education, consulting, construction, health care, engineering and design, waste management, petroleum, facilitates management, retail, transportation, and utilities. Within these contexts, safety professionals must adapt their functions to fit the mission, operations, and climate of their employer.

Not only must safety professionals acquire the knowledge and skill to perform their functions effectively in their employment context, but also through continuing education and training they stay current with new technologies; changes in laws and regulations, and changes in the workforce, workplace, and world business, political, and social climate.

(continued next page)

Figure 1-1. ASSE scope and functions of the professional safety position

Figure 1-1 *(continued)*

As part of their positions, safety professionals must plan for and manage resources and funds related to their functions. They may be responsible for supervising a diverse staff of professionals.

By acquiring the knowledge and skills of the profession, developing the mind-set and wisdom to act responsibly in the employment context, and keeping up with changes that affect the safety profession, the safety professional is able to perform required safety professional functions with confidence, competence, and respected authority.

Functions of the Professional Safety Position

The major areas relating to the protection of people, property, and the environment are:

A. Anticipate, identify, and evaluate hazardous conditions and practices.

1. Developing methods for
    a. anticipating and predicting hazards from experience, historical data, and other information sources.
    b. identifying and recognizing hazards in existing or future systems, equipment, products, software, facilities, processes, operations, and procedures during their expected life.
    c. evaluating and assessing the probability and severity of loss events and accidents which may result from actual or potential hazards.
2. Applying these methods and conducting hazard analyses and interpreting results.
3. Reviewing, with the assistance of specialists where needed, entire systems, processes, and operations for failure modes; causes and effects of the entire system, process, or operation; and any subsystems or components due to
    a. system, subsystem, or component failures.
    b. human error.

c. incomplete or faulty decision making, judgments, or administrative actions.

d. weaknesses in proposed or existing policies, directives, objectives, or practices.

4. Reviewing, compiling, analyzing, and interpreting data from accident and loss event reports, and other sources regarding injuries, illnesses, property damage, environmental effects, or public impacts to

   a. identify causes, trends, and relationship.

   b. ensure completeness, accuracy and validity, or required information.

   c. evaluate the effectiveness of classification schemes and data collection methods.

   d. initiate investigations.

5. Providing advice and counsel about compliance with safety, health, and environmental laws, codes, regulations, and standards.

6. Conducting research studies of existing or potential safety and health problems and issues.

7. Determining the need for surveys and appraisals that help identify conditions or practices affecting safety and health, including those which require the services of specialists, such as physicians, health physicists, industrial hygienists, fire protection engineers, design and process engineers, ergonomists, risk managers, environmental professionals, psychologists, and others.

8. Assessing environments, tasks, and other elements to ensure that physiological and psychological capabilities, capacities, and limits of humans are not exceeded.

B. Develop hazard control designs, methods, procedures, and programs.

1. Formulating and prescribing engineering or administrative controls, preferably before exposures, accidents, and loss events occur to

(continued next page)

Figure 1-1 *(continued)*

a. eliminate hazards and causes of exposures, accidents, and loss event.

b. reduce the probability or severity of injuries, illnesses, losses, or environmental damage from potential exposures, accidents, and loss events when hazards cannot be eliminated.

2. Developing methods which integrate safety performance into the goals, operations, and productivity of organizations and their management and into systems, processes, and operations or their components.

3. Developing safety, health, and environmental policies, procedures, codes, and standards for integration into operational policies of organizations, unit operations, purchasing, and contracting.

4. Consulting with and advising individuals and participating on teams

   a. engaged in planning, design, development, and installation or implementation of systems or programs involving hazard controls.

   b. engaged in planning, design, development, fabrication, testing, packaging, and distribution of products or services regarding safety requirements and application of safety principles that will maximize product safety.

5. Advising and assisting human resources specialists when applying hazard analysis results or dealing with the capabilities and limitations of personnel.

6. Staying current with technological developments, laws, regulations, standards, codes, products, methods, and practices related to hazard controls.

C. Implement, administer, and advise others on hazard controls and hazard control programs.

1. Preparing reports that communicate valid and comprehensive recommendations for hazard controls which are based on analy-

sis and interpretation of accident, exposure, loss event, and other data.

2. Using written and graphic materials, presentations, and other communication media to recommend hazard controls and hazard control policies, procedures, and programs to decision-making personnel.

3. Directing or assisting in planning and developing educational and training materials or courses. Conducting or assisting with courses related to designs, policies, procedures, and programs involving hazard recognition and control.

4. Advising others about hazards, hazard controls, relative risk, and related safety matters when they are communicating with the media, community, and public.

5. Managing and implementing hazard controls and hazard control programs that are within the duties of the individual's professional safety position.

D. Measure, audit, and evaluate the effectiveness of hazard controls and hazard control programs.

1. Establishing and implementing techniques, which involve risk analysis, cost, cost-benefit analysis, work sampling, loss rate, and similar methodologies; for periodic and systematic evaluation of hazard control and hazard control program effectiveness.

2. Developing methods to evaluate the costs and effectiveness of hazard controls and programs and measure the contribution of components of systems, organizations, processes, and operations toward the overall effectiveness.

3. Providing results of evaluation assessments, including recommended adjustments and changes to hazard controls or hazard control programs, to individuals or organizations responsible for their management and implementation.

4. Directing, developing, or helping to develop management accountability and audit programs which assess safety performance of entire systems, organizations, processes, and operations or their components and involve both deterrents and incentives.

Hazard Recognition: identifying conditions or actions that may cause injury, illness, or property damage.

Hazardous Materials Management: ensuring dangerous chemicals and other products are stored and used in such a manner as to prevent accidents, fires, and the exposure of people to these substances.

Health Hazard Control: recognizing, evaluating, and controlling hazards that can create undesirable health effects, including noise, chemical exposures, radiation, or biological hazards.

Inspection/Audit: evaluating/assessing safety and health risks associated with equipment, materials, processes, or activities. Inspections and audits differ. A more detailed explanation is provided in chapter 10.

Recordkeeping: maintaining safety and health information to meet government requirements, as well as provide data for problem solving and decision making.

Regulatory Compliance: ensuring all mandatory safety and health standards are satisfied.

Security: maintaining an environment safe from outside forces. Safety professionals may also find themselves heavily involved in such issues as security in the workplace, as was the case on 9/11 and more recently in San Bernardino, California and natural disaster management to include weather-related events and earthquakes. While these lists provide examples of specific activities performed by the safety professional, the American Society of Safety Engineers (ASSE), now known as the American Society of Safety Professionals, has published a document titled "Scope and Functions of the Professional Safety Position." This publication presents a broad picture of the safety professional's roles and responsibilities (see figure 1-1).

Training: providing employees with the knowledge and skills necessary to recognize hazards and perform their jobs safely and effectively.

International Adaptability: being prepared to operate in legal and cultural environments outside of the United States. A key consideration may be the geographic location of the safety professional, as there are increasing numbers of safety positions in other countries. As a result, safety professionals must now adapt to the appropriate cultures (American Society of Safety Engineers Foundation & Board of Certified Safety Professionals, 2007). According to the International

Labour Organization (ILOa, 2017), there are more than 2.78 million deaths per year, as a result of work-related accidents or diseases. There are more than 374 million non-fatal, work-related injuries and illnesses occurring annually. The total cost of illnesses, injuries and deaths was 3.94 percent of the global GDP, or $2.99 trillion (ILOb, 2017). This results in an estimate of 4 percent impact on the overall Gross Domestic Product (GDP) (International Network of Safety and Health Practitioner Organisations [INSHPO], 2017). Currently, there is no common, international set of laws or regulations governing practice by safety professionals as they move from country to country. With increasing numbers of multi-national organizations, and a growing number of safety professionals working abroad, guidance, beyond compliance with the U.S. Code of Federal Regulations (CFRs) is needed for these international safety practitioners.

According to Kathy Seabrook (2017, October), President of Global Solutions and former President of the American Society of Safety Engineers, there are certain assumptions safety practitioners considering working outside of the United States must consider:

- Each country has its own compliance requirements. These requirements may and likely will differ from OSHA requirements in the United States
- Safety professionals need to understand how the country's regulatory agency interacts with organizations in the country. For example, in Western Australia, surprise inspections can be expected, as in the U.S. This may differ by country, and working professionals need to understand how they work.
- Each country's injury reporting and workers' compensation programs are very different.
- U.S. regulations tend to be more prescriptive than regulations in many other countries. For example, European regulations tend to be more performance-oriented.
- Countries usually build their regulations based on historical relationships. Those closer to the U.S. will typically model after OSHA. Those historically linked to the UK or Europe tend to go in their respective directions. China is placing increasing emphasis on construction regulations.

- It is important to understand the specific culture of the workers in the country where operations are occurring.
- The next big thing in terms of OSH regulations or guidance will be on psycho-social risks. There is increasing emphasis in Europe, and this is expected to make its way to the U.S.
- Sustainability is another major push in terms of safety guidance. It is expected to have more increasing influence on safety guidance and regulations
- VPP is not a management system. It can be incorporated into one. A system is important for training and various operations.
- ISO 45001 is on the horizon. It will likely provide the primary guidance toward establishment of a safety management system on a world-wide basis.
- The primary demand for safety jobs appears to be those related to occupational safety

From a general industry perspective, a leader in establishing standards for overall safety and health guidance is the International Labour Organization (ILO). The ILO brings together governments, employers, and worker representatives from 187 member states. Their aim is to promote rights at work, encourage decent employment opportunities, enhance social protection, and strengthen dialogue on work-related issues. The ILO has established a model code of safety regulations for industrial establishments for the guidance of both governments and industry. Most of their member countries have adopted the International Labor Standards. In any location of operation, another consideration is safety ethics.

SAFETY AND ETHICS: DO YOU? DON'T YOU?

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Background

Acme Engineering specializes in the design and manufacture of custom equipment and facilities. Over the years, the company has gravitated to-

ward designing and making equipment and facilities used in the manufacture of building products. The company has an excellent reputation and is considered the best in its field. Due to the global recession, business over the past several years has been slow. Profits have stagnated and talks of potential layoffs are now taking place.

Recently, the sales department received a Request for Proposal (RFP) from a foreign company based in a third-world country. The RFP calls for design of engineering drawings of a high-speed facility specializing in residential-housing building products. Only drawings and specifications are required; another business will actually build and operate the facility. Once complete, the design project will generate approximately $50 million in needed revenues for Acme. Due to its strong, world-wide reputation, Acme is the only company receiving the RFP. A team is assembled to ensure requirements of the proposal can be met in the specified time.

In discussions one of the team members (Tom) questions the fact that, due to the geology of the region where the plant will be built, there are no sources of raw materials readily available. The only option is to rely on recycled sources from a local salvage company. Unfortunately, the recycled material is slightly radioactive. The amount of radiation generated is just below EPA legal standards for similar products found in the US. The Acme legal department begins a review of applicable laws and regulations and finds there are no parallel regulations in the country where the materials are to be produced and used, and since Acme is not going to build or operate the plant, there is no apparent company liability.

Tom's concern is that Acme would not even consider engaging in the design of this plant if it were to be built in the USA. Others on the team sympathize with Tom's position, but point out several key issues:

- Acme is not going to build or operate the plant
- There are no laws or regulations prohibiting the manufacture and use of these products in the foreign country
- If Acme turns down the proposal, a competitor will step up to the plate and gladly take the $50 million
- Acme desperately needs the influx of funds

Tom seeks the assistance of an epidemiologist to estimate what, if any, adverse health effects might be generated by houses built with products made from the waste material. After careful research and calculation, the epidemiologist estimates there will likely be 28–30 excess lung cancer deaths occurring 35–40 years after construction.

The committee cannot come to consensus, but all notes are sent to the company's top executives. After careful consideration of the facts and arguments, the executive group decides not to go forward with submission of a proposal. The decision is based on several key issues, including the fact that the company is not willing to provide the designs, if the plant is to be built in the United States. Additionally, none of the executive group will consider having any of their own family members living in a house constructed with the recycled material.

When contacted by the foreign company, none of the company's competitors steps up to submit a proposal. The plant is never built, so the necessary building products are imported from another location with safe sources for the raw materials.

BUSINESS ETHICS

There are those who define *ethics* as a moral thermometer of right and wrong; that is, there are no absolutes, but the extremes are clearly understood. In most cases it is really only the actions at the "wrong" end of the thermometer that are truly of concern. The real challenge for societies, companies, and individuals is that there is often no one clear definition of right and wrong. On an individual level, decisions about right and wrong derive from family, church, schools, community, and government. All of these impact the development of the individual belief systems and moral guideposts, and they ultimately influence behaviors.

These same factors influence how organizations address or fail to address ethical practices. Organizations are the sum of the parts; that is, the individuals who are members of any given organization influence the ethical standards of that organization. Most societies have certain expectations for the way its members conduct themselves in given circumstances. These social behaviors or expectations are based on the shared belief systems of the group as a whole.

Because of the diversity in any community or organization there are also differences in expected social norms or ethical behavior. This often results in conflicts and contrary interests that generate ethical dilemmas. Within this context, management operates and attempts to effectively utilize resources (i.e., time, money and personnel) to generate a profit and/or meet shareholder expectations. Since these resources are not unlimited, managers are forced to make difficult decisions on how and where to expend them.

In the case study, management considered maximizing profits, while insulating themselves from legal liability. The issue, when examined under the legal microscope, gave a clear signal that no laws were being violated; however, when placed under the ethical microscope, the impact of their decision became clearly a moral one. Outside observers would likely agree that the managers ultimately made the right decision, even though it was not easy to make in considering potential financial profits to be reaped by the company. So how does one apply the ethical thermometer as a guide for decisions?

- Consider the saying, "If it sounds like the deal is too good to be true, it probably is." One needs to carefully check the facts to assure that everything is in order and above board.
- Look at how the decision or choice will appear in the "light of day." The decision may eventually become front-page news in the local paper or on the national news. How will it be perceived by the other professionals and the public at large?
- Attempt to remove the emotion and make the decision as objectively as possible. Weigh the pros and cons in light of both the legal and moral consequences. How will the results of the decision affect not only you and your company but the company constituents, the general public, the environment, and anyone else who may be impacted?
- Lastly, review the guidelines of such organizations as the Board of Certified Safety Professionals. Compare your decision to those guidelines and see if it stands up against careful scrutiny.

Assume you are one of six purchasing agents for a manufacturing company. You all deal with many vendors to order raw materials and supplies at the lowest cost and highest quality for your company. One day you

receive a call from a vendor you and several other agents deal with on a regular basis. The vendor invites you and another person of your choice to their company's exclusive hunting lodge, all expenses paid. The contact suggests you keep this customer-goodwill trip to yourself; none of your peers have been invited.

In this case, several questions need to be asked. . . .

Does this seem too good to be true? Why are they offering it to me and no one else? How will I feel if others find out about this? What are the pros and cons of making this decision and how will it affect others, including my employer? Others also include my co-workers, my boss, my subordinate, and even my competitors. Is this ethical in light of corporate purchasing guidelines and other professional guidance that may be available?

It should become clear in this simple example that the vendor is trying to curry favor with the purchasing agent to ensure continued and future sales. The issue of customer goodwill is nothing more than a bribe to keep and solidify business. How would it make others feel about me? Would this objectively be considered ethical or unethical?

So, what is a businesses expected to do to ensure ethical behavior by and to their employees? In the global economy and multi-national corporations, executives are responsible for a very diverse workforce with differing values and beliefs as to what is considered right and wrong. It is critical that each business establish an ethics policy to help guide and clarify the expected behaviors of managers and employees in business dealings. The policy needs to address not only areas of general business practices, but also expectations for dealings with customers, vendors and its employees. The ethics policies will establish broad boundaries and provide important guideposts so employees can act within the expectations of their organization. Early approaches to establishing ethics policies simply stated that all employees are expected to obey the laws that apply to their business dealings. This can be an important beginning, but the example presented earlier demonstrates that meeting the "legal" standards may not be sufficient to address ethical standards for the same activity or behavior.

On the following pages are samples of ethics policies from two corporations to further clarify this issue.