



OSHAcademyTM
Occupational Safety & Health Training

Hazard Analysis and Control

By taking this course, safety directors, safety committee members, supervisors, and managers will gain a greater ability to identify the various categories of hazards in their workplace, and apply strategies used to make sure hazards are eliminated or reduced. Emphasis is placed on applying the "hierarchy of controls" strategies to eliminate hazards.

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OSHAcademy Course 704 Study Guide

Hazard Identification, Analysis, and Control

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Contact OSHAcademy to arrange for use as a training document.

This study guide is designed to be reviewed off-line as a tool for preparation to successfully complete OSHAcademy Course 704.

Read each module, answer the quiz questions, and submit the quiz questions online through the course webpage. You can print the post-quiz response screen which will contain the correct answers to the questions.

The final exam will consist of questions developed from the course content and module quizzes.

We hope you enjoy the course and if you have any questions, feel free to email or call:

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Course Introduction

The Occupational Safety and Health Act of 1970 requires that each employer "...furnish to each of his employees' employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm..." (29 U.S.C. 651, Sec. 5(a)(1)).

Basic Employer Responsibilities

The employer should see that workers are properly instructed and supervised in the safe operation of any machinery, tools, equipment, process, or practice which they are authorized to use or apply. This should not be construed to require a supervisor positioned on every part of an operation or to prohibit workers from working alone.

The employer should take all reasonable means to require employees:

- work and act in a safe and healthful manner;
- conduct their work in compliance with all applicable safety and health rules;
- use all means and methods, including but not limited to, ladders, scaffolds, guardrails, machine guards, safety belts and lifelines, that are necessary to safely accomplish all work where employees are exposed to a hazard; and
- not remove, displace, damage, destroy or carry off any safety device, guard, notice or warning provided for use in any employment or place of employment while such use is required by applicable safety and health rules.

Every employer should be responsible for providing the health hazard control measures necessary to protect the employees' health from harmful or hazardous conditions and for maintaining such control measures in good working order and in use.

Employers should inform the employees regarding the known health hazards to which they are exposed, the measures which have been taken for the prevention and control of such hazards, and the proper methods for utilizing such control measures.

Basic Employee Responsibilities

All employees should conduct their work in compliance with their employer's safety policies and rules. Employees should report all injuries immediately to the person in charge or other responsible representative of the employer. Employees should make full use of safeguards provided for their protection.

If your employer does not currently have general formal/written safety rules, please begin now to make sure these rules and others specific to your workplace are written and communicated to employees.

Safety Inspections

Employers should make sure their workplaces are inspected by a qualified person or persons as often as the type of operation or the character of the equipment requires. Defective equipment or unsafe conditions found by these inspections should be replaced or repaired or remedied promptly. Make sure a written and dated report, signed by the person or persons making the inspection, is completed and used to provide information to improve the safety management system.

Course Objectives

This online course will cover some of the basic principles and concepts related to hazard identification and control. More specifically, if you complete the reading and assignments, at the end of the course, you will be able to:

- identify the 13 general workplace hazard categories
- describe the four primary procedures used to identify hazards
- discuss the various accident types that might result if hazards are not corrected
- describe possible engineering and management hazard control strategies
- discuss various problem-solving techniques to help control hazards
- prepare an effective recommendation

Module 1: Basic Concepts

Introduction

The goal of the hazard identification and control program is to make the workplace and its operations as safe as possible and to keep employees from being harmed. It is an ongoing program that is actually never finished. If you are involved in developing a system to identify and control hazards:

1. carefully plan and design interrelated processes and procedures
2. implement and carefully watch the system perform
3. revise and improve preventive measures and controls as your worksite changes and as your store of hazard information grows.

If you are going to be effective in protecting employees from workplace hazards, obviously you must first understand just what those hazards are.

1. Your company's Hazard Identification and Control Program is ____.

- a. a waste of money most of the time
- b. never finished
- c. only successful with enforcement
- d. the safety committee's responsibility

Identifying the Hazards

It's important that workers and supervisors are knowledgeable to ensure that workplace hazards are identified and eliminated as soon as possible. You've got to know what you're looking for. Examples of the various kinds of hazards include:

- Hazardous materials including raw materials (wood, metal, plastic) that are manufactured into finished goods and toxic chemicals (solvents, acids, bases, detergents) used at various stages of the process.
- Machinery and equipment may not be properly guarded or in poor working order because of poor preventive/corrective maintenance.

- Tools may not be properly maintained. Saws may not be sharpened, or safety harnesses may be old and in need of replacement.
- The work environment might include extreme noise, flammable or combustible atmospheres, or poor workstation design. Floors may be slippery, and aisles cluttered. Guardrails, ladders, or floor hole covers may be missing or damaged.
- Employees might be fatigued, distracted in some way, or otherwise lack the mental or physical capacity to accomplish work safely.

Some or all these potential safety hazards may exist in a workplace and the list could be much longer. When inspecting the workplace, look for hazardous conditions **and** situations such as unsafe behaviors that could cause exposure. Remember, it takes both a hazard and exposure to the hazard before an accident can occur.

Hazard + Exposure ⇒ Possible Accident

2. Before an accident can occur, what two conditions must be met?

- a. A hazard and a behavior
- b. Bad timing and a situation
- c. A hazard and exposure to the hazard
- d. Exposure and unsafe behavior

What is a Hazard?

Before we study identifying, analyzing and controlling hazards in the workplace, it's important to know how OSHA defines the term. OSHA usually defines a hazard as, "a danger which threatens physical harm to employees." Expanding on that basic definition we can think of a hazard as:

"unsafe workplace conditions or practices (dangers) that could cause an injury or illness (harm) to employees. "

A hazard may be an object (tools, equipment, machinery, materials) or a person (when distracted, mentally/physically incapable). It's important to know that a hazard is only one part in the "accident formula" above. It takes a hazard and exposure before an accident can occur.

Look Around

I'll bet if you look around your workplace, you'll be able to locate a few hazardous conditions or work practices without too much trouble. Did you know that at any time an OSHA inspector could announce his or her presence at your corporate front door to begin a comprehensive inspection? What would *they* find? What do *they* look for? Now, if you used the same inspection strategy as an inspector, wouldn't that be smart? Let's look at some information contained in [OSHA's Field Compliance Manual, Chapter 3](#), relating to hazards and exposure.

3. Which of the following most closely summarizes OSHA's definition of a hazard?

- a. People, places, or things
- b. Anything that could injure
- c. A danger which threatens harm
- d. A condition or practice

Employer's Obligation

OSHA's [General Duty Clause](#) requires that:

"Each employer shall furnish to each of his employees' employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees."

This section also states:

"The employer shall comply with occupational safety and health standards promulgated under this Act."

The following are examples of some types of hazardous exposures that employers have an obligation to prevent according to the General Duty Clause and various OSHA standards:

- Employees are working at the unguarded edge of an open-sided floor 30 feet above the ground in apparent violation of 1926.501(b)(1). The regulation requires that the edge of the open-sided floor be guarded by standard guardrail systems. The type of hazard the employer must prevent is a fall from the edge of the floor to the ground below.
- Employees are working in an area in which debris is located in apparent violation of 1915.91(b). The type of hazard the employer must prevent is employees tripping on debris.

- An 8-hour time-weighted average sample reveals regular, ongoing employee overexposure to methylene chloride at 100 ppm in apparent violation of 1910.1052. The type of hazard the employer must prevent is exposure to methylene chloride above the PEL mandated by the standard (25 ppm).

4. According to the General Duty Clause, employers must furnish employment and a workplace free from hazards that are causing or are likely to cause ____.

- a. a debilitating injury
- b. death or serious physical harm
- c. an injury or illness
- d. serious physical harm or mental illness

“Recognized” Hazards

Occasionally, students ask what is considered a "recognized" hazard in the workplace. As described in OSHA's Field Compliance Manual, recognition of a hazard is established on the basis of industry recognition, employer recognition, or "common sense" recognition criteria.

- **Industry Recognition.** A hazard is recognized if the employer's industry recognizes it. Recognition by an industry, other than the industry to which the employer belongs, is generally insufficient to prove industry recognition. Although evidence of recognition by the employer's specific branch within an industry is preferred, evidence that the employer's industry recognizes the hazard may be sufficient.
- **Employer Recognition.** A recognized hazard can be established by evidence of actual employer knowledge. Evidence of such recognition may consist of written or oral statements made by the employer or other management or supervisory personnel during or before the OSHA inspection, or instances where employees have clearly called the hazard to the employer's attention.
- **Common Sense Recognition.** If industry or employer recognition of the hazard cannot be established, recognition can still be established if it is concluded that any reasonable person would have recognized the hazard. This argument is used by OSHA only in flagrant cases. Note: Throughout our courses we argue that "common sense" is a dangerous concept in safety.

Employers should not assume that accidents in the workplace are the result of a lack of common sense.

5. If employees have called a hazard to the attention of their employer, in which category would OSHA classify the hazard?

- a. Industry recognition
- b. Employer recognition
- c. Employee recognition
- d. Common sense recognition

"Foreseeable" Hazards

Another important question to ask about the nature of a hazard relates to whether it was "foreseeable." The question of foreseeability should be addressed by safety managers during the root cause analysis phase of an accident investigation. A hazard for which OSHA issues a citation must be reasonably foreseeable. All the factors which could cause a hazard need not be present in the same place at the same time in order to prove foreseeability of the hazard; e.g., an explosion need not be imminent. For example:

- If combustible gas and oxygen are present in sufficient quantities in a confined area to cause an explosion if ignited but no ignition source is present or could be present, no OSHA violation would exist. If an ignition source is available at the workplace and the employer has not taken sufficient safety precautions to preclude its use in the confined area, then a foreseeable hazard may exist.

It is necessary to establish the reasonable foreseeability of the general workplace hazard, rather than the particular hazard which led to the accident. For example:

- A titanium dust fire may have spread from one room to another only because an open can of gasoline was in the second room. An employee who usually worked in both rooms was burned in the second room from the gasoline. The presence of gasoline in the second room may be a rare occurrence. It is not necessary to prove that a fire in both rooms was reasonably foreseeable. It is necessary only to prove that the fire hazard, in this case due to the presence of titanium dust, was reasonably foreseeable.

6. During which phase of an accident investigation should the question of "foreseeability" be addressed by safety managers?

- a. Root cause phase
- b. Surface cause phase
- c. Recommendation phase
- d. Initial analysis phase

What is "Exposure"?

Now, let's talk about the concept of "exposure": the second variable in the accident formula. Exposure is generally defined as "the condition of being exposed," or as "a position in relation to a hazard." In this course we will consider three forms of exposure that we'll discuss here: physical; environmental; and potential exposure.

Physical exposure: We may think of this form of exposure as "arm's length" exposure. If any part of the body can be injured as a result of proximity to a danger zone, physical exposure exists. For instance, if an employee removes a guard and works around moving parts that could cause an injury, that employee is exposed.

Physical exposure also occurs by **inhalation**, **ingestion**, and **absorption** primarily through skin contact. Skin exposure may result in dermatitis or skin rash, edema or swelling, and blistering. These exposures can result from chemical splashes and spills, from directly immersing one's hands into solvents and chemicals, from contact with solvent-soaked clothing or solvent-wet objects, and from the use of improper personal protective equipment. Solvents can dissolve the body's natural protective barrier of fats and oils leaving the skin unprotected against further irritation.

Environmental exposure: An employee may suffer from environmental exposure no matter how far away from the source of the hazard he or she might be. For instance, if an employee uses a loud saw all day, everyone working around the saw may be exposed to hazardous levels of noise and suffer from environmental exposure.

Potential Exposure: The possibility that an employee could be exposed to a hazardous condition exists when the employee can be shown to have access to the hazard. Potential employee exposure could include one or more of the following:

- When a hazard has existed and could recur because of work patterns, circumstances, or anticipated work requirements and it is reasonably predictable that employee exposure could occur.
- When a hazard would pose a danger to employees simply by employee presence in the area and it is reasonably predictable that an employee could come into the area during the course of the work, to rest or to eat at the jobsite, or to enter or to exit from the assigned workplace.
- When a hazard is associated with the use of unsafe machinery or equipment or arises from the presence of hazardous materials and it is reasonably predictable that an employee could use the equipment or be exposed to the hazardous materials in the course of work.

7. Which kind of exposure is sometimes referred to as "arm's length" exposure?

- a. Psychological exposure
- b. Potential exposure
- c. Environmental exposure
- d. Physical exposure

Module 2: Hazard Categories

Introduction

In the first module, we began a discussion of the concepts of "hazard" and "exposure" in preparation for a further look in this module. Here we will take a closer look at the five general hazard categories and 13 more specific hazard categories. All this will help you improve your knowledge and skills in proactive hazard identification to help eliminate hazards in the workplace. So, let's get studying!

Five General Hazard Areas

All workplace hazards exist in five general areas. You can remember them by using the mnemonic, "MEEPS". Here are some examples:

- **Materials** - liquids, solids, gases, etc.
- **Environment** - noise, radiation (non-ionizing and ionizing), humidity, temperature, atmospheres, workstation design
- **Equipment** - includes machinery, tools, devices
- **People** - anyone in the workplace (i.e., employees, guests, customers or contractors)
- **System** - flawed policies, programs, plans, processes, procedures, and practices

1. Which one of the five hazard categories includes liquids, solids, and gases?

- a. Materials
- b. Management
- c. Equipment
- d. Environment

What You See and Don't See

When you conduct a walkaround inspection you are usually looking for hazardous materials, equipment, and environmental factors. These hazard areas represent hazardous physical conditions that are rather easily recognized by the employer. However, they cause only a small percentage of all accidents in the workplace: well under 10 percent.

OSHA inspectors primarily cite hazardous conditions because they're easy to see, and "what OSHA sees, they cite." OSHA is very good at uncovering the conditions that don't cause many accidents. However, OSHA is not so good at spotting unsafe behaviors that cause most accidents. If the inspector is lucky (see video) they might catch someone violating safety rules, but that is the exception, not the rule. It's a flawed system, but it's all we have.

Most company safety inspections are no better. Safety committee members, supervisors, or safety managers walk around looking for hazardous conditions. They rarely see an unsafe practice occurring. This flaw in the inspection process also explains why there is little correlation between the most frequently cited violations and the most frequent causes of injury. For instance, ergonomic hazards, which frequently cause injuries, are not yet addressed in OSHA standards.

2. Which of the following is LEAST likely to be uncovered during a walkaround safety inspection?

- a. Unsafe workspaces
- b. Defective equipment
- c. Hazardous chemicals
- d. Unsafe behaviors

Sober and Focused

The fourth category, "People," refers to any employee (or others) at any level of the organization who may not be "sober and focused" on the work they're doing. For example, an employee might be in a hazardous "state of being" if they are:

- in a hurry
- under the influence of drugs or alcohol;
- poorly trained or educated;
- worried about a family illness;
- too tired to do the job; or
- distracted for any reason.

Remember, an employee who is distracted in from the work they're doing should also be considered a "walking hazardous condition" that increases the likelihood of an unsafe behavior. Today, distraction is becoming a big problem with the use of cell phones, especially while people are walking or driving. Unfortunately, OSHA does not usually observe employees working in an unsafe manner, so you don't see unsafe behaviors described in OSHA citation reports too often.

The safety management system is composed of policies, programs, plans, processes, procedures, and practices that may influence or contribute to distraction and other unsafe behaviors in the workplace. A flawed safety management system will contribute to workplace conditions and behaviors. Therefore, we can argue that the failure of the safety management system is ultimately the root cause for the majority of the workplace accidents.

3. What is ultimately the root cause for the majority of workplace accidents?

- a. Failure of the safety management system
- b. Distracted employees
- c. A lack of common sense
- d. Lack of management competence

Hazardous Materials

Nearly every production job involves the use of hazardous materials including chemicals for cleaning, stripping, or degreasing parts and equipment. Maintenance workers who enter enclosed or confined spaces are also exposed to toxic substances.

Solvents: Solvents are used to dissolve various materials. Solvents may affect the central nervous system, acting as depressants and anesthetics causing headaches, nausea, drowsiness, dizziness, complaints of irritation, abnormal behavior, general ill-feeling, and even unconsciousness. These symptoms should be viewed as visible signs of potential disease. Excessive and continued exposure to certain solvents may result in liver, lung, kidney, and reproductive damage, as well as cancer. Those commonly used include:

Common types of solvents:

trichloroethylene	toluene
acetone	methylene chloride
perchloroethylene	glycol ether
isopropyl alcohol	chloroform
xylene	freon

Acids and Alkalis: Acids and alkalis may cause serious burns if they are splash into the eyes or onto the skin. If vapors or mists are inhaled, they may result in a burning of the linings of the nose, mouth, throat, and lungs.

Metals: Employees are exposed to metals primarily by skin contact and by inhalation of metal dusts and fumes. Exposure may cause headaches, general ill-feeling, anemia, central nervous system and kidney damage, and reproductive problems, as well as cancer.

Gases: Gases are used in many operations and may combine with other substances to produce toxic gases such as phosgene, ozone, and carbon monoxide. Workers can be exposed to these and other gases during work. Potential exposure to gases occurs through inhalation. Such exposure may produce eye damage, headaches, shivering, tiredness, nausea, and possible kidney and liver damage.

Plastics and Resins: Inhalation or skin contact may occur when curing resins; cutting, heating, or stripping wires; or cutting, grinding, or sawing a hardened product. Exposure to these substances may result in skin rash and upper respiratory irritation.

Polychlorinated Biphenyls (PCBs): PCBs are used as insulators in some electrical equipment and present a potential hazard to workers. Exposures to PCBs may cause skin disorders, digestive problems, headaches, upper respiratory irritations, reproductive problems, and cancer.

Fiberglass and Asbestos: Fiberglass and asbestos are also used as fillers in epoxy resins and other plastics, in wire coatings or electrical insulation, and in printed circuit boards. Uncontrolled exposures may produce skin and upper respiratory irritations and, in the case of asbestos, cancer.

Solids: Solids like metal, wood, plastics. Raw materials used to manufacture products are usually bought in large quantities and can cause injuries or fatalities in many ways.

Gases: Gases like hydrogen sulfide, methane, etc. Gas may be extremely hazardous if leaked into the atmosphere. Employees should know the signs and symptoms related to hazardous gases in the workplace.

4. These types of hazardous materials may cause serious burns if they are splashed into the eyes.

- a. Solvents
- b. Plastics and resins
- c. Acids and alkalis
- d. Gases

Hazardous Equipment

Hazardous equipment includes vehicles, machinery, and tools.

- Hazardous equipment should be properly guarded so that it's virtually impossible for a worker to be placed in a danger zone around moving parts that could cause injury or death.
 - A **preventive maintenance** program should be in place to make sure equipment operates properly.
 - A **corrective maintenance** program is needed to make sure equipment that is broken, causing a safety hazard, is fixed immediately.
- Tools need to be in good working order, properly repaired, and used for their intended purpose only. Any maintenance person will tell you that accidents can easily occur if tools are not used correctly. Tools that are used while broken are also very dangerous.

5. Which program should be in place to make sure equipment operates properly?

- a. A corrective maintenance program
- b. A preventive maintenance program
- c. An as-needed maintenance program
- d. A just-in-time lean maintenance program

Hazardous Work Environments

The work environment includes all areas where work is being performed. Examples include work environments that are too noisy, bright, dark, hot, cold, dusty, dirty, messy, or wet. Is it too noisy, or are dangerous gases, vapors, liquids, fumes, etc., present? Such factors all contribute to an unsafe environment. You can bet a messy workplace is NOT a safe workplace! Common environmental hazards include:

Noise Exposure: Many workplaces are inherently noisy and potentially hazardous to employees. Continuous noise and instantaneous noise bursts can damage the hearing of employees. A hearing conservation program should be established if you think noise levels are a potential threat to the health of your employees. OSHA consultants, your insurer, or a private consultant are all available to help you determine noise levels in the workplace.

Electric Shock: Electricity travels in closed circuits, normally through a conductor. Shock occurs when the body becomes part of the electric circuit. The current must enter the body at one point and leave at another. Shock normally occurs in one of three ways. The person must come in contact with:

1. both wires of an energized electrical circuit,
2. one wire of an energized electrical circuit and the ground, or
3. an energized "hot" metallic part and the ground.

Illumination: It's important to make sure illumination is adequate for the job being performed. Too much direct or indirect glare can, over time, cause eye strain. Too little light can result in an injury. More on this topic in course 711, Introduction to Ergonomics.

6. Which of the following may cause an electric shock to a person?

- a. Contact with the ground wire of an electrical circuit
- b. Contact with any metal and the ground
- c. Contact with both wires of an energized electric circuit
- d. Contact with the non-metallic part of a wire

Hazardous People

Remember, hazardous conditions can be thought of as an unsafe "state of being." All the following situations may cause employees to be what I call "walking and working hazards."

- *Fatigue*: Employees are too tired to do the work without causing injury to themselves or others.
- *Drugs or alcohol*: Drugs (either legal or illegal) and alcohol place employees in altered states of awareness and lengthens reaction time.
- *Distraction*: Employees who are distracted (internal thoughts are not focused on the work being performed). You can't be thinking about the football game while working on high voltage!
- *Hurry*: This should be obvious. This is probably the greatest reason employees perform unsafe actions. The more hurried employees are, for whatever reason, the more likely they are going to have accidents.

Workers who take unsafe short cuts, or who are using established procedures that are unsafe, are accidents waiting to happen. As mentioned earlier, hazardous work practices represent about 95% of the causes of all accidents in the workplace. Bottom-line: If employees are not sober and focused while working, they are walking hazardous conditions.

- Management may unintentionally promote unsafe work practices by establishing policies, procedures and rules (written and unwritten) that ignore or actually direct unsafe work practices. These safety policies, plans, programs, processes, procedures and practices are called "**system controls**" and ultimately represent the causes of about 98% of all workplace accidents.

Hazardous System

Every company has, to some degree, a safety management system. Management may unintentionally promote unsafe behaviors by developing ineffective policies, procedures and rules (written and unwritten) that ignore safe behaviors or actually direct unsafe work practices. Safety policies, plans, programs, processes, procedures and practices are called "Administrative Controls," and they ultimately represent the causes for about 98% of all workplace accidents.

7. What is probably the greatest reason employees perform unsafe actions?

- a. They are under the influence of drugs or alcohol
- b. They are fatigued
- c. They are stressed by others
- d. They are in a hurry

13 Hazard Categories

The following 13 hazard categories are adapted from *Product Safety Management and Engineering*, by Willie Hammer, [ASSE](#) Pub. This publication is an excellent text to add to your library. (Image credits: Oregon OSHA)

1. *Acceleration*: This is just a fancy term for "fall" hazard. Acceleration happens when we speed up or slow down too quickly. It also occurs when any object is being set in motion or its speed increased. Whiplash is a common injury as a result of an acceleration hazard. Hazards from deceleration and impact, especially from falls, also exist in the workplace.
2. *Biohazards*: Hazards of harmful bacterial, viruses, fungi, and molds are becoming a greater concern to everyone at work. The primary routes of infection are airborne and bloodborne.
3. *Chemical reactions*: Chemical reactions can be violent, and can cause explosions, dispersion of materials and emission of heat. Chemical compounds may combine or break down (disassociate) resulting in chemicals with reactive properties. Corrosion, the slow combination of iron and water, is a common chemical reaction and results in loss of strength and integrity of affected metals.

4. *Electrical hazards*: Exposure to electrical current. There are six basic electrical hazards: shock, ignition, heating/overheating, inadvertent activation (unexpected startup), failure to operate, and equipment explosion.

8. What type of hazard are employees exposed to when working from any height above the ground?

- a. Mechanical hazard
- b. Acceleration hazard
- c. Environmental hazard
- d. Vibration hazard

5. *Ergonomics*: The nature of the work being done may include force, posture, position of operation characteristics that require hazardous lifting, lowering, pushing, pulling, and twisting. The results are strains and sprains to muscles and connective tissues.
6. *Explosives and explosions*: Explosions result in quick (instantaneous) releases of gas, heat, noise, light and over-pressure. High explosives release a large amount of energy. Low explosives burn rapidly (deflagrates) but at a slower speed. Most explosive accidents are caused by explosions of combustible gases.
7. *Flammability and fires*: In order for combustion to take place, the fuel, an oxidizer, and ignition source must be present in gaseous form. Accidental fires are commonplace because fuel, oxidizers and ignition sources are often present in the workplace.
8. *Temperature*: Temperature indicates the level of sensible heat present in a body. Massive uncontrolled flows of heat or temperature extremes in either can cause trauma and/or illness.

9. What type of hazard are employees exposed to when physically lifting or lowering equipment as part of their work?

- a. Ergonomic hazard
- b. Vibration hazard
- c. Acceleration hazard
- d. Psychosocial hazard

9. *Mechanical hazards*: Tools, equipment, machinery and any object that may contain pinch points, sharp points and/or edges, weight, rotating parts, stability, ejected parts and materials that could cause injury.
10. *Pressure*: Increased pressure in hydraulic and pneumatic systems. Pressure may cause ruptures in pressure vessels and whipping hoses. Small high-pressure leaks may cause serious injuries.
11. *Radiation*: Electromagnetic radiation hazards vary depending on the frequency (wavelength) of the energy. Generally, the higher the frequency, the more severe the potential injury. Non-ionizing (ultra-violet, visible light) may cause burns. Ionizing radiation actually has the potential to destroy tissue by dislodging electrons from atoms making up body cells.
12. *Toxics*: Materials that in small amounts may cause injury to skin and internal organs are considered toxic. Toxics may enter through inhalation, ingestion, absorption, or injection.
13. *Vibration/Noise*: Produce adverse physiological and psychological effects. Whole-body vibration is a common hazard in the trucking industry. Segmental vibration and noise hazards exist when working with equipment such as jack hammers.

10. What type of hazard is an employee exposed to using a tool with rotating parts?

- a. Pressure hazard
- b. Toxic hazard
- c. Mechanical hazard
- d. Vibration/noise hazard

Module 3: Identifying Hazards

Introduction

The first step in controlling workplace hazards is to first identify them. We want to determine what hazards are present. Once hazards are identified, you'll conduct an analysis so examine, more closely, the nature of the hazard. You want to know what it looks like, what kind of accidents it may cause, and how severe the resulting injuries may be. Analysis requires that each item or component be examined to see how it relates to or influences the whole.

Safety inspections should do more than simply identify hazardous conditions. They should provide useful data for the purpose of effective analysis and evaluation of the safety management system.

There are five basic methods you can use to identify workplace hazards before an accident occurs:

- Informal and formal observation programs;
- Comprehensive company-wide surveys;
- Individual interviews;
- Walk-around inspections; and
- Documentation review.

As we'll learn, observing work each day is extremely important in identifying hazards. Surveys take advantage of employee awareness of the presence of workplace hazards. Interviews are valuable in uncovering hazardous conditions, unsafe work practices, and their root causes. Walk-around inspections are useful to locate hazardous conditions and, to a lesser degree, unsafe work practices in the workplace. Reviewing documentation such as the OSHA 300 Log, safety committee minutes and accident reports also helps to determine workplace hazards. Now, let's take a look at each of these five methods or "tools" to identify hazards.

1. What is the first step in controlling workplace hazards?

- a. Understand the hazards
- b. Identify the hazards
- c. Create a checklist
- d. Supervise daily activities

Informal Observation and Formal Observation Programs

An informal observation process is nothing more than being watchful for hazards and unsafe behaviors throughout the work shift. No special procedure is involved. All employees should be expected to look over their work areas once in a while.

One of the most effective proactive methods to collect useful data about the hazards and unsafe behaviors in your workplace is the formal observation program because it includes a written plan and procedures. For example, safety committee members or other employees who may be assigned to complete a minimum number of observations of safe/unsafe behaviors during a given period of time. This data is gathered and analyzed to produce graphs and charts reflecting the current status and trends in employee behaviors. Posting the results of these observations tends to increase awareness and lower injury rates. But, more importantly, the data gives valuable clues about safety management system weaknesses.

Observation is important because it can be a great tool to effectively identify behaviors that account for 95 percent of all workplace injuries. The walkaround inspection, as a method for identifying hazards, may not be as effective as observation in identifying unsafe behaviors.

Note: An important policy for successful formal observation procedures is that they are not, in any way, linked to discipline. Observers should not discipline or "snitch" on employees: To do so ensures any observation program will fail as an accurate fact-finding tool. I recommend using only employees who do not have authority to discipline as observers in the program. If you must use managers or supervisors, make sure they do not observe in their own areas of responsibility, and make sure they understand the policy regarding "no discipline" as a consequence of an observation. It is also important for observers to express appreciation when safe behaviors are observed and remind or warn employees to use safe practices if they are not performing a task safely.

2. What is considered one of the most effective proactive methods to collect useful data about hazards and unsafe behaviors in your workplace?

- a. Employee interviews
- b. Surveys
- c. Formal observations
- d. Accident investigations

Comprehensive Surveys

Comprehensive surveys are not the same as interviews or inspections. An interview is a verbal exchange conducted one-on-one, preferably in private, and has the potential to gather more information. An inspection is often done by employees at the workplace who walk around observing the workplace and asking questions in public.

Comprehensive surveys ideally should be performed by people who can bring to your worksite fresh vision and extensive knowledge of safety, health, or industrial hygiene. Because there are few professional consultants equipped to do comprehensive surveys in all three areas, the best approach is to use a team consisting of outside specialists: a safety professional and an industrial hygienist.

We encourage you to take advantage of OSHA's safety and health consultative services if available in your state. Just call your local OSHA field office and schedule a visit. Workers' compensation insurance providers and other insurance companies offer expert services to help their clients evaluate safety and health hazards. Private consultants may also provide excellent specialized services to help determine workplace hazards.

For an industrial hygiene survey, you should, at a minimum, inventory all chemicals and hazardous materials in the plant, review your hazard communication program, and analyze air samples. For many industries, a survey of noise levels and a review of the respirator program also will be vital. Companies participating in OSHA's [SHARP](#) and [VPP](#) must conduct initial comprehensive surveys.

3. Who should ideally perform comprehensive surveys?

- a. People from unrelated functional areas
- b. Someone with little interest in the outcome
- c. A team of outside specialists
- d. Those who do not have preconceived ideas

Interviewing Employees

Interviews differ from surveys. Whereas surveys ask many people the same questions, an interview is a one-on-one process that asks a set of unique questions. Outside experts or in-house competent persons may conduct the interviews. You can get a wealth of valuable information from interviews that can far exceed what might be possible from a survey.

When conducting the interview keep the following tips in mind.

Conducting Tips

- **Go to the work area to conduct the interview.** Just because you are familiar with the location or the employee's job, don't assume that things are always the same.
- **Put the person at ease.**
- **Keep the purpose of the interview in mind:** It's to get the employee's help in determining the types of hazards that exist in his or her work area.
- **Explain the purpose and your role.** Tell the employee exactly why you are conducting the interview to reduce any initial reluctance to participate.
- **Stress that the information given is important.** It may help eliminate hazards that have the potential to kill, injure or produce illness. Information given may also help to make the work procedure more efficient too.
- **Be friendly, understanding, and open minded.** Try to keep the interview informal. Your approach is important. Make sure they sense that you care about their safety.
- **Be calm and unhurried.** If you are agitated, or in a hurry to get the interview over, you'll be sending a negative message that the employee will see.
- **Let the individual talk.** Don't interrupt while they are talking. It's easy to think you have all the information. Many important facts may not be uncovered if you cut them off.
- **Actively listen.** Repeat the information given. Rephrase. Communicate to understand.
- **Take notes.** Notes should be taken very carefully, and as casually as possible. Let the individual read them if desired.

- **Use a tape recorder.** But always get permission from the employee first. Offer to give them a copy of the tape if they hesitate.

Tips on Asking Questions

- **Ask background information, name, job, etc . . .** This just helps to smoothly transition into the actual interview. Small talk...then get to business.
- **The key initial statement.** Ask the witness to tell you about the hazards they are aware of. Don't ask them if they know of any hazards: they could easily just say "no."
- **Don't ask leading questions.** They are not on trial.
- **Ask follow-up questions.** This will help to clarify particular areas or get specifics.
- **Do not put the person on the defensive.** To avoid being perceived as accusatory, don't ask why-you questions.
- **Try to avoid "yes/no" closed-ended questions. The most effective questions are open-ended. For example, the opening of an effective question might be, "Tell me about the procedures for..."**
- **Thank the employee.** Conclude the interview with a statement of appreciation for their contribution.
- **Be available.** Ask them to contact you if they think of anything else.
- **Provide feedback.** If possible, advise the person the outcome of the interview.

4. Which type of question is most effective in getting information during an interview?

- a. Leading question
- b. Closed-ended (yes/no) question
- c. Accusatory (why/you) question
- d. Open-ended question

Workplace Inspections

Inspections are the best understood and most frequently used tool to assess the workplace for hazards. Much has been written about them, and many inspection checklists are available in various OSHA publications. The term "inspection" means a general walk-around examination of every part of the worksite to locate conditions that do not comply with safety standards. This includes routine industrial hygiene monitoring and sampling.

Inspection Frequency

The regular site inspection should be done at specified intervals. The employer should inspect as often as the type of operation or character of equipment requires. Think about the most hazardous operation or location in your company. How often are safety inspections conducted there?

OSHA expects all places of employment to be inspected by a qualified person or persons as often as the type of operation or the character of the equipment requires. Defective equipment or unsafe conditions found by these inspections should be replaced or repaired or remedied promptly.

The frequency of the safety inspection is really a judgment call for the employer, but at a minimum, medium and large fixed worksites should be inspected completely at least every quarter, with some part of the inspection occurring each month. The frequency of a safety inspection depends on the nature of the work and workplace. More frequent change and higher probability for serious injury or illness requires more frequent inspection. For construction sites, daily inspections are a must because of the rapidly changing nature of the site and its hazards.

At small fixed worksites, the entire site should be inspected at one time. And even for the smallest worksite, inspections should be done at least quarterly. If the small worksite uses hazardous materials or involves hazardous procedures or conditions that change frequently, inspections should be done more often.

Sound Safety Inspection Policy: All employees should inspect their area of responsibility at the beginning and end of each shift and bridge the inspections with continual observation. If a hazardous condition is observed, eliminate it if you safely can, or report it immediately.

5. What criteria should be used to determine the frequency of a safety inspection?

- a. OSHA requirements
- b. The nature of the work and workplace
- c. Best practices
- d. Stated employer policy

What Should We Inspect?

A consistently effective safety inspection will follow a procedure based on the inventory of hazards specific to the workplace. The inventory will include the hazard prevention actions and controls designed to reduce or eliminate worker exposure. Some important points to remember include:

- Develop safety inspections to check for specific hazards to make sure that they are properly controlled using the Hierarchy of Controls.
- Do not overlook areas outside of the production mainstream.
- Your search for common hazards and OSHA standards violations should cover the entire worksite, including all office areas.

Who Should Inspect?

From your reading earlier, you already know that the safety committee may be responsible for conducting regular safety inspections. But that is where it ends, and that should not be. Supervisors and other employees should be conducting safety inspections on a regular basis.

Supervisors: Supervisor's should inspect their work areas at the beginning of every shift to ensure equipment and personnel are ready to work safely. This policy is particularly important when other shifts use the same area and equipment or when after-hours maintenance and cleaning are routinely done. And a good walkaround inspection always sends a message to employees that safety is important.

Employees: Involving employees in all aspects of the safety and health program, including hazard identification and control, is smart business. Get as many employees involved as you can.

- **Safety committee members:** Safety committees may be assigned safety inspection responsibilities, but we do not recommend that the employer rely solely on safety committees to perform inspections.
- **Safety professionals and staff:** Employees who specialize in safety and health can be an excellent source of help in providing the necessary education and training on hazard identification. In a small business, the specialist may be a Production/Quality Control manager or another member of management with many important duties in addition to safety and health.

6. A consistently effective safety inspection will follow a procedure based on ____.

- a. OSHA requirements and guidelines
- b. input from the safety committee
- c. a quarterly schedule in each department
- d. an inventory of hazards specific to the workplace

Training for Safety Inspectors

Everyone conducting safety inspections needs to be thoroughly trained on how to effectively conduct safety inspections and in the specific hazards in their workplaces. It doesn't do any good for employees, supervisors and safety committee members to be conducting safety inspections if they don't know what to look for.

- **Supervisors:** Supervisors should be properly educated about their safety inspection responsibilities. They should have training in identifying and controlling the hazards that workers under their supervision are likely to encounter. Formal course work may not be necessary, but the training should be provided by the safety manager or other competent person. When training supervisors, it's important to make sure they understand that it is their responsibility for safety in their departments. They "own" whatever happens in work areas for which they supervise. It's not the primary job of the safety manager or the safety committee to ensure safe work conditions and behaviors. Ultimately, safety is a line (operations/production), not a staff (administration) responsibility.
- **Employees:** Employees should have training in the hazards that they may be exposed to during work. When they are responsible for workstation inspections, employees also should

have specific training in how to inspect. On-the-job training with the supervisor can be an excellent strategy to ensure adequate instruction on conducting inspections and training on how to detect and correct hazards to which they are exposed.

- **Safety committee members:** Safety committee members should understand the potential hazards to which they might be exposed and the ways they can protect themselves and their fellow workers. Those who are involved in inspections need training in recognizing and controlling all the potential hazards of the worksite. They will also need written guidance, tips for inspecting, and some on-the-job training by safety and health staff or other specialists.
- **Safety professionals and staff:** Of course, safety professionals and staff should be the "resident experts" in safety inspection procedures and should receive initial and ongoing advanced education.

7. Supervisor training must make sure they know that ultimately, safety ____.

- a. is the safety manager's job
- b. is a line, not a staff, responsibility
- c. is a safety committee function
- d. is a staff, not the supervisor's responsibility

Written Inspection Reports

In all but the smallest and least dangerous of workplaces, written inspection reports are necessary to record hazards discovered, responsibility assigned for correction, and tracking of correction to completion. Formal safety inspections should include a written report with recommendations for corrective action.

A written record will help ensure:

- assignment of responsibility for hazard correction
- tracking of correction to completion
- identification of problems in the controls system when the same types of hazards keep appearing even after correction is verified

- identification of problems in the accountability system
- identification of hazards for which no prevention or control has been planned

Of course, having such written records will be most helpful if they are read by someone knowledgeable in the safety and health program. This person then can provide top managers with summaries of problems.

Beware of "Tunnel Vision"

If you use experts from within your company, be on guard for "tunnel vision," which can lead to a failure to spot hazards in areas not directly related to your firm's primary function. You want your maintenance shop, for example, to be just as safe as your production line. OSHA frequently finds unguarded saws and grinders, non-code electrical wiring, and other basic safety hazards in areas that are outside the main production process but regularly used by employees.

8. Which of the following should be part of a written inspection report?

- a. Those responsible for taking corrective actions
- b. Employees being observed during the inspection
- c. Disciplinary actions taken during the inspection
- d. Employer responsibilities after the inspection

Review Documents

Assessing the workplace wouldn't be complete without thoroughly reviewing existing documents to determine what kinds of hazards have existed in the workplace prior to the assessment. Actually, document review may be considered both an assessment tool and an analysis tool. Not only are we able to determine the hazards that have caused accidents in the past, we can analyze to uncover trends in the types, locations, date/time, etc. for accidents.

Review these documents to assess workplace hazards:

- OSHA 300 Log (of course)
- OSHA Form 301, Injury and Illness Incident Report
- maintenance work orders

- accident reports
- safety committee minutes
- safety suggestions
- training evaluations

All these activities to identify hazards in the workplace are so important to the overall effectiveness of your safety management system. Be sure you integrate these activities into the line positions...employees, supervisors and managers...safety is a line responsibility!

9. What can you uncover in an analysis of the documents gathered from interviews, inspections, and observations?

- a. The rate at which common sense is not being displayed
- b. The departments having the most accidents
- c. Trends in the types of accidents occurring
- d. The employees who should be placed on a "watch list"

Module 4: Analyzing the Workplace

Beyond Identification

To identify workplace hazardous conditions, unsafe behaviors, and safety management system failures, we should conduct surveys and interviews, safety inspections, and audits. But merely identifying these defects is not good enough. We need to get beyond the mere identification of hazards: We need to determine how those defects impact overall safety in the workplace. To do that we must conduct an analysis: But what is it?

Analysis - How Each Part Impacts the Whole

When conducting analysis, we closely examine each part of a policy, program, plan, process, procedure or task to determine its impact on the whole. There are various forms of analysis used to improve safety in the workplace. In this module we'll look at:

- Job Hazard Analysis
- Change Analysis
- Process Hazard Analysis
- Phase Hazard Analysis

To get a better idea how analysis is conducted, let's look at a couple of examples:

- if we are conducting a Job Hazard Analysis (JHA), we'll look at each step of the job to determine the impact each step has on the whole job.
- if we are conducting a Process Hazard Analysis (PHA), we'll look at each procedure in the process to determine its effect on the entire process.

Bottom line: Remember, the purpose of analysis is to learn how each part impacts the whole.

1. The process of analysis ____.

- a. determines the presence or absence of an item
- b. examines parts to determine their impact on the whole
- c. is the first step in controlling workplace hazards
- d. examines the whole to understand each part

Job Hazard Analysis Process

This is the most basic and widely used tool for routine hazard analysis. It is sometimes called job safety analysis. The supervisor conducting the analysis (usually the supervisor) can follow these basic steps:

1. Meet with the employee before the JHA begins. Ask the employee to help you conduct the JHA by performing the job in the usual manner. It's important that the employee feel comfortable doing work while being monitored.
2. Begin by asking the employee to join you in breaking down a job into a series of unique steps in column one of the JHA form. This is best done by describing each step in order of occurrence as you watch an employee performing the job.
 - a. Make sure you watch at least five to six cycles of the procedure to get an accurate list of steps.
 - b. It's a good idea to use a videotape recorder so that you and the employee can review the procedure while conducting the rest of the JHA.
3. Next, examine each step to determine the hazardous conditions or unsafe work practices that exist or that might occur. Reviewing the job steps and hazards with the employee performing the job will help make sure there is an accurate and complete list.
 - a. Manufacturer's equipment operating instructions or Safety Data Sheets (SDSs) should also be considered.
 - b. Think about root causes for each hazard identified so that permanent corrective actions can be made.

- c. Make sure you list hazards for all steps in column two of the form before moving on to the next phase of the JHA.

2. What is the most basic and widely used tool for routine hazard analysis?

- a. Job Hazard Analysis
- b. Phase Analysis
- c. Process Hazard Analysis
- d. Change Analysis

- 4. Determine whether the hazardous conditions can be eliminated, or the job could be performed differently to reduce exposure to the hazards. Would it help to combine steps or change the sequence? Are safety equipment and other precautions needed?
 - a. If a safer way of performing the job is possible, list each new step, being as specific as possible about the new procedure.
 - b. If no safer way to perform the job is feasible, determine whether any physical changes will eliminate or reduce the danger. These might include redesigning equipment, changing tools, adding machine guards, using personal protective equipment, or improving ventilation.
- 5. Finally, write a new safe job procedure that includes each of the safe practices you identified. Use the following guidelines
 - a. Write the procedure in a step-by-step format
 - b. Use easy-to-read language (preferably about 8th grade level).
 - c. Assume you are actually demonstrating the procedure to one person.
 - d. Write the procedure in present tense, second person (you), and active verbs.

After completing the draft standard job procedure, review them with all employees performing the job. Obtaining their ideas about the hazards and proposed changes is an important part of this process. It will help ensure that your proposed changes are sensible and are accepted by the workers you are trying to protect.

3. Which of the following guidelines is recommended for writing a JHA safe job procedure?

- a. Write at the 12th grade level to make sure everyone understands
- b. Assume you are demonstrating the procedure to a group of employees
- c. Write in the second person, present tense, using active verbs
- d. Avoid a step-by-step format to ensure clarity

Which is More Effective: The Inspection or JHA?

The Job Hazard Analysis is more effective in eliminating and reducing injuries and illnesses in the workplace because it not only uncovers hazardous conditions, it also identifies unsafe work practices and procedures. The walk-around inspection, just by the nature of the process, limits the time an inspector can give to analyzing work practices. Consequently, the inspection emphasizes assessing for conditions. Unfortunately, most accidents are the result of unsafe practices and procedures.

The JHA, on the other hand, does take the time necessary to critically analyze each step of a job for both hazardous conditions and unsafe practices. The result is that most of the causes for accidents are discovered and changes made to prevent their occurrence. An effective JHA has the potential of significantly reducing injury and illness rates in the workplace.

The JHA may also be used by the employer as a training tool. In fact, the JHA can become a very useful lesson plan for conducting on-the-job training on hazardous tasks for new employees.

Sample Job Hazard Analysis

BASIC TASK STEP	HAZARDS - POSSIBLE INJURIES	PREVENTIVE MEASURES
1. Spotter: Spot position of trailer as it nears loading dock.	Spotter could be caught between trailer and dock.	Caution: Stay clear of the rear of the trailer as it is being backed into position. Note: Keep others away from the area.
2. Driver: When trailer is in position, turn engine off, set parking brake, and notify forklift operator.	Driver could be injured if he/she jumps off the truck.	Warning: Never jump off the cab or back of the trailer.
3. Driver: Set chocks.	Driver could strike head on trailer. Driver could trip, slip, fall while in the dock well.	Warning: Avoid striking the trailer when setting the wheel chocks. Caution: Use handrails and use care when walking on slippery surfaces.
SAFE JOB PROCEDURE		
Step 1. Spotter: Position the vehicle. Spot the position of the trailer as it nears the loading dock. Make sure the trailer is correctly positioned in the dock well. Warning: It's important to follow these procedures so you don't get caught between the trailer and dock when the trailer is backing up to the dock. Note: Be sure to keep others away from the area. Remove the awareness chain or bar from the front of the dock door once the trailer is properly positioned. Step 2. Driver: When the trailer is in position, verify the vehicle has been turned off, set the parking brake set, and notify the forklift operator. Warning: When exiting the truck, never jump. Many drivers are injured jumping from the cab of the truck or back of the trailer. Step 3. Driver: Set the chocks. After exiting the truck, chock the wheels. Warning: Be sure not to strike your head against the truck with setting the chocks. Caution: Be careful when walking on slippery surfaces and use handrails when using ramps or stairs.		

4. Why is the JHA better than the safety inspection as a tool to help keep employees safe?

- a. It takes less time to accomplish
- b. It identifies hazards and unsafe behaviors
- c. Employees don't have to be trained
- d. It is required for all tasks in the workplace

Change Analysis

Anytime you bring something new into your worksite, whether it is a piece of equipment, different materials, a new process, or an entirely new building, you unintentionally may introduce new hazards. If you are considering a change for your worksite, you should analyze it thoroughly beforehand.

Change analysis is cost-effective in terms of the human suffering and financial loss it prevents. Moreover, heading off a problem before it develops is usually less expensive than attempting to fix it after the fact.

An important step in preparing for a worksite change is considering the potential effect on your employees. Individuals respond differently to change, and even a clearly beneficial change may confuse employees and increase the risk of accidents. You will want to inform all affected employees of the change, provide training as needed, and pay attention to employee responses until everyone has adapted.

Building or Leasing a New Facility

Even something as basic as a new facility needs to be reviewed carefully to identify hazards it might pose. A design that seems to enhance production of your product and appears delightful to the architect may be a harmful or even fatal management decision. Have safety and health experts take a careful look beforehand at all the design/building plans.

Installing New Equipment

An equipment manufacturer does not know how its product will be used at your worksite. Therefore, you cannot rely totally on the manufacturer to have completely analyzed and prepared controls or safe procedures for the product. Moreover, if the equipment is produced in a foreign country, it may not meet clear requirements of U.S. standards and laws. Therefore, involve health and safety professionals in the purchase decision and in the installation plans.

5. What type of analysis would you conduct when you change a process or get new equipment or materials?

- a. Phase Analysis
- b. Job Hazard Analysis
- c. Change Analysis
- d. Process Hazard Analysis

Using New Materials

Before introducing new materials to your production processes, research the hazards that the materials themselves present. Also try to determine any hazards that may appear due to the processes you plan to use with the materials. Some traditional materials, such as lead in paint, are dangerous to use but are replaceable with less hazardous mixtures. For other materials, you may not be able to find adequate substitutes. You may need to establish controls for the hazards these materials present.

Starting Up New Processes

New processes require workers to perform differently. Consequently, new hazards may develop even when your employees are using familiar materials, equipment, and facilities. Carefully develop safe work procedures for new processes. After the operators have become familiar with these procedures, perform routine hazard analysis (discussed below) to discover any hidden hazards.

Analyzing Multiple Changes

Often a big change is composed of several smaller changes. When you begin producing a new product, chances are you will have new equipment, materials, and processes to monitor. Make sure each new addition is analyzed not only individually, but also in relation to the other changes.

Once you have analyzed the changes at your worksite, add this information to your basic inventory of hazards. This inventory is the foundation from which you design your hazard prevention and control program.

6. Why should the employer be concerned when new processes are introduced in the workplace?

- a. OSHA will always check new processes first
- b. New processes require a close inspection
- c. New processes require employees to work differently
- d. The inventory of hazards must be updated

Process Hazard Analysis (PHA)

What is the definition of a "process" in this type of analysis? A process can be defined as any series of actions or operations that convert raw material into a product. The process can terminate with a finished product ready for consumption or with a product that is the raw material for subsequent processes.

A process hazard analysis is a detailed study of a process to identify every possible hazard to employees. Every element of the process must be studied. Each action of every piece of equipment, each substance present, and every move made by an employee must be assumed initially to pose a hazard to employees. Process hazard analysis will include hazards with:

- Mechanical and chemical operations;
- Low and high temperature and pressure operations;
- Possible high levels of radiant energy;
- Direct contamination of employees; and
- Contamination of the air with toxic substances.

The best time for an employer to conduct a process hazard analysis is when the process is first being designed, before equipment is selected. This review, in turn, will assist you in choosing process equipment for its effective, efficient, and safe operation. Be sure to consider the equipment's capacity for confining the process within predetermined safety limits. The type, number, and location of detectors you select for monitoring the process should ensure not only productive operation, but also safe operation. Remember to take into account any substance or mixture of substances that could present fire or explosion hazards.

When you have selected your equipment, the information from the process hazard analysis will help you to develop an appropriate inspection and maintenance schedule.

Who Should Conduct the PHA?

OSHA believes that a team approach is the best approach for performing a process hazard analysis, because no one person will possess all of the necessary knowledge and experience. Additionally, when more than one person is performing the analysis, different disciplines, opinions, and perspectives will be represented, and additional knowledge and expertise will be contributed to the analysis. At least one member of the team should be an employee who has experience with and knowledge of the process being evaluated.

7. When is the best time to conduct a process hazard analysis on a piece of equipment?

- a. After equipment is selected
- b. Before employees are trained
- c. When the business opens
- d. When a process is first being designed

Preparing for the Unplanned Event

When dealing with high hazard chemicals or volatile explosives, it is not enough to analyze only those hazards associated with normal operations: those times when the process works as expected. You need to analyze for unexpected or unplanned events. To do that you can use analytical tools such as:

- **Job Hazard Analysis (JHA):** This is a tool to identify hazards associated with a particular job or task. Hazards are identified and recorded. Control measures are developed for each hazard in each step of the task.
- **What-if analysis:** This is a technique using brainstorming to determine what can go wrong in specific scenarios and identify the resulting consequences.
- **Checklists:** This is a structured process for hazard/risk assessment and is the most commonly-used method. There are two basic types of checklists: process-based and behavior-based.
- **Hazard and operability study (HAZOP):** This is a technique whereby a multidisciplinary team uses a described protocol to methodically evaluate the significance of deviations from the normal design intention.

- **Failure mode and effect analysis (FMEA):** This is an evaluation of the means that equipment can fail or be used improperly, and the effects this failure can have on the process.
- **Fault-tree analysis:** This is a graphical model that illustrates combinations of failures that will cause one specific failure of interest. It uses Boolean logic symbols to break down the causes of an event into basic equipment or human failure.

Using the methods above, you can determine most of the possible process breakdowns. You then can design prevention/controls for the likely causes of these unwanted events.

For additional information on Process Hazard Analysis, see OSHA's Process Safety Management of Highly Hazardous Chemicals standard, 1910.119 and OSHA Publication 3133 (Revised 1994), "Process Safety Management - Guidelines for Compliance."

8. Which of the following analytical tools is used to identify hazards associated with a particular job or task?

- a. What-if analysis
- b. Checklists
- c. Hazard and operability study (HAZOP)
- d. Job Hazard Analysis (JHA)

Phase Hazard Analysis

Phase hazard analysis is a helpful tool in construction and other industries that involve a rapidly changing work environment, different contractors, and widely different operations. A phase is defined as an operation involving a type of work that presents hazards not experienced in previous operations, or an operation where a new subcontractor or work crew is to perform work.

In this type of hazard analysis, before beginning each major phase of work, the contractor or site manager should assess the hazards in the new phase. He/she should not only coordinate appropriate supplies and support, but also prepare for hazards that can be expected and establish a plan to eliminate or control them.

To find these hazards and to eliminate or control them, you will use many of the same techniques that you use in routine hazard analysis, change analysis, process analysis, and job analysis. One major additional task will be to find those hazards that develop when combinations of activities occur in

close proximity. Workers for several contractors with differing expertise may be intermingled. They will need to learn how to protect themselves from the hazards associated with the work of nearby colleagues as well as the hazards connected to their own work and the hazards presented by combinations of the two kinds of work.

When Should the Project Phase Analysis Occur?

It is best to conduct a thorough pre-planning phase analysis that involves all contractors (if possible) in the process. The sooner you can anticipate and respond to potential hazards, the better. At the beginning of each phase, an additional phase analysis would also be appropriate to make sure all contingencies have been addressed.

Putting it all Together

Job hazard analysis, process hazard analysis, and phase analysis are all important tools you can use to make the workplace safe and healthful for workers. Remember, the analysis process begins with having industrial hygiene, safety, and occupational health experts conduct comprehensive assessments of your worksite to help you initially determine the existing and potential hazards.

9. When is the best time to conduct phase analysis?

- a. After each phase is completed
- b. Once work has begun on the project
- c. During the pre-planning phase
- d. After the project has been completed

Module 5: Controlling Hazards

The Hierarchy of Controls (HOC)

As you learned earlier, there are many different types of hazards in the workplace.

- Hazardous conditions include: unsafe materials, equipment, environment and employees.
- Unsafe work practices include: allowing untrained workers to perform hazardous tasks, taking unsafe shortcuts, horseplay, or long work schedules.

To combat hazardous conditions and unsafe work practices, various "Hierarchy of Controls" (HOC) models have been developed. We have adopted a HOC that includes two prioritized hazard control **strategies** and four prioritized **control methods**. See the HOC strategies and controls listed below:

Control Strategies

1. Elimination: The most important strategy.
2. Mitigation

Control Methods

1. Engineering controls: The most important control method.
2. Warnings
3. Administrative controls
4. Personal protective equipment

The highest priority control method is the use of engineering controls because it is considered most effective. As you can see, no matter which control method is selected, the most important strategy is to totally eliminate the hazard or exposure. If elimination is not possible, mitigation, or the reduction of the severity of the hazard or exposure, is the strategy selected.

1. Which of the following is listed as one of the two exposure control strategies?

- a. Warnings
- b. Engineering Controls
- c. Mitigation
- d. Administrative controls

"Feasible" Controls

Hazard control measures required to correct a hazard must be technologically and economically feasible for the employer. OSHA uses the criteria below to determine feasibility of engineering and administrative controls.

- **Technical Feasibility:** Technical feasibility is the existence of technical know-how as to materials and methods available or adaptable to specific circumstances which can be applied to cited violations with a reasonable possibility that employee exposure to occupational health hazards will be reduced.
- **Economic Feasibility:** Economic feasibility means that the employer is financially able to undertake the measures necessary to abate identified hazards. Economic feasibility is a major issue to be considered when imposing hazard controls.

OSHA may allow the use of PPE to abate a hazard, at least until such time as engineering controls become a less significant economic burden for the company when the following conditions are met:

1. If significant reconstruction of a single establishment involving a capital expenditure which would seriously jeopardize the financial condition of the company is the only method whereby the employer could achieve effective engineering controls;
2. If there are no feasible administrative or work practice controls; and
3. If adequate personal protective equipment or devices are available.

2. Hazard control measures required by OSHA to correct a hazard must be technologically and economically ____.

- a. feasible
- b. applied
- c. defined
- d. demonstrated

Elimination and Mitigation

As mentioned earlier, the two most fundamental strategies in achieving the goal of a safe and healthful workplace is to either eliminate or mitigate hazards and exposure.

1. **Elimination.** The first and most important strategy is to use hazard control methods to totally eliminate a hazard and exposure. The highest priority is to remove the hazard, but if that's not possible, try to eliminate exposure to the hazard.
2. **Mitigation.** If elimination of a hazard or exposure is not possible, try to reduce the severity of the hazard. If you can't reduce the severity of a hazard to an acceptable level, try to reduce exposure to the hazards.

As you can see, elimination is the first priority, and if that's not possible, mitigation should be attempted. Some examples of these two strategies include:

- Elimination. Install a conveyor belt to remove the need to carry objects.
- Elimination. Use an extension pole to change ceiling lights to remove the need for a ladder.
- Mitigation. Substitute a toxic chemical with a less toxic chemical.
- Mitigation. Redesign equipment to reduce the noise it produces.
- Mitigation. Replace heavy boxes with smaller, lighter boxes to store products.

3. Which hazard control strategy would be used to completely remove the source of excessive temperatures, noise, or pressure?

- a. Mitigation
- b. Administration
- c. Elimination
- d. Training

Engineering Controls

These controls focus on eliminating or reducing the actual source of the hazard, unlike other control strategies that generally focus on employee exposure to the hazard. The basic concept behind engineering controls is that, to the extent feasible, the work environment and the job itself should be designed to eliminate hazards or reduce exposure to hazards. While this approach is called engineering controls, it does not necessarily mean that an engineer is required to design the control. Redesigning or replacing equipment or machinery may be expensive, but remember, according to the National Safety Council, the cost per medically consulted injury in 2013 was \$42,000, and the cost per death was \$1,450,000.

Remember: No hazard or No exposure = No accident.

Engineering controls do not necessarily have to be expensive or complicated. They can be quite simple in some cases. Engineering controls are based on the following broad strategies:

1. If feasible, design or redesign the tools, equipment, machinery, materials and/or facility.
2. Enclose the hazard to prevent exposure in normal operations; and
3. If complete enclosure is not feasible, establish barriers or local ventilation to reduce exposure to the hazard in normal operations.

Some examples of this strategy include:

- Redesigning a process to reduce exposure to a hazardous moving part;
- Redesigning a work station to relieve physical stress and remove ergonomic hazards; or

- Designing general ventilation with sufficient fresh outdoor air to improve indoor air quality and generally to provide a safe, healthful atmosphere.

4. Why are engineering controls preferred over administrative and work practice controls to correct workplace hazards?

- a. Because safety is all about conditions, not behavior
- b. They are designed to eliminate or isolate the hazard
- c. They focus on employee exposure
- d. They cost less in the long run

Enclosure of Hazards

When you cannot remove a hazard and cannot replace it with a less hazardous alternative, the next best control is enclosure. Enclosing a hazard usually means that there is no hazard exposure to workers during normal operations. However, workers may still be potentially exposed during maintenance operations or if the enclosure system breaks down. For those situations, additional controls such as safe work practices or personal protective equipment (PPE) may be necessary to control exposure.

Some examples of enclosure designs are:

- Complete enclosure of moving parts of machinery;
- Complete containment of toxic liquids or gases from the beginning to end of a process;
- Glove box operations to enclose work with dangerous microorganisms, radioisotopes, or toxic substances; and
- Complete containment of noise, heat, or pressure producing processes with materials especially designed for those purposes.

Barriers or Local Ventilation

When the potential hazard cannot be removed, replaced, or enclosed, the next best approach is a barrier to exposure or, in the case of air contaminants, local exhaust ventilation to remove the contaminant from the workplace. This engineered control involves potential exposure to the worker even in normal operations. Consequently, it should be used only in conjunction with other types of

controls, such as safe work practices designed specifically for the site condition and/or PPE. Examples include:

- ventilation hoods in laboratory work
- machine guarding, including electronic barriers
- isolation of a process in an area away from workers
- baffles used as noise-absorbing barriers
- nuclear radiation or heat shields

5. Because these control methods involve potential exposure to the worker during normal operations, they should only be used in conjunction with other types of controls.

- a. Enclosure of hazards
- b. Engineering controls
- c. Barriers or local ventilation
- d. Elimination and Substitution

Warnings

With the release of ANSI Z10-2012, "warnings" have been promoted to their own hierarchy level. Previously they were considered part of administrative controls. Warnings do not prevent exposure to a hazard, but they do provide a visual or audible indicator to warn people of potential danger.

Warnings can be either visual, audible, or both. They may also be tactile. Some examples of warnings are:

- **Visual.** Signs, labels, tags, and flashing/strobe lights.
- **Audible.** Alarms, bells, beepers, sirens, announcement system and horns.
- **Tactile.** Vibration devices or air fans.

For instance, a door could have both a sign warning of a hazard as well as an alarm if opened. Warnings can be effective deterrents, but are not as effective as elimination, substitution, or engineering controls.

OSHA Signs

OSHA's [1910.145, Specifications for accident prevention signs and tags](#) details the following types of signs:

- **Danger Signs** - Signs that alert people to specific and immediate dangers (including radiation hazards).
- **Warning Signs** - Signs that warn people of potential hazards that can lead to death.
- **Caution Signs** - Signs used to alert people to potential hazards. This class can also be used to caution people against certain unsafe practices. This class is for hazards that can result in minor (non-life threatening) accident or injury.
- **Safety Instruction Signs** - These signs offer instructions for how someone should act or perform to avoid possible hazards.

One potential problem when using warnings is the misinterpretation of the warning itself. Does the symbol or text clearly explain what the hazard is to the public? For example, if a sign only contains a written warning, someone might read the sign but not know what the warning actually means. Or, if an alarm sounds, what does the alarm mean? These are challenges when using warnings and why they are not as effective as higher-level controls.

6. Signs, labels, tags, and flashing/strobe lights are examples of _____ warning devices.

- a. visual
- b. audible
- c. tactile
- d. sensory

Administrative Controls

Administrative controls work by developing safety policies, programs, procedures, and designing safe work practices into job procedures. Ultimately, administrative controls can potentially influence workplace behaviors causing most of the workplace accidents.

Administrative controls are only as effective as the safety management system that supports them. It's always better to eliminate the hazard so that you don't have to rely on management controls that tend to work only as long as employees behave. Here's an important principle that reflects this idea:

Any system that relies on human behavior is inherently unreliable.

To make sure management controls are effective in the long term, they must be designed from a base of solid hazard analysis and sustained by a supportive safety culture. They then must be accompanied by adequate resources, training, supervision, and appropriate consequences. Remember, administrative controls should be used in conjunction with, and not as a substitute for, more effective or reliable engineering controls. Now let's look at some examples of some administrative controls.

7. Any system that relies on human behavior is inherently ____.

- a. inefficient
- b. unreliable
- c. effective
- d. unacceptable

Safe Work Practices

Administrative controls also take the form of safe work practices. They may be quite specific or general in their applicability. They may be a very important part of a single job procedure or applicable to many jobs in the workplace. Safe work practices include:

- Removing tripping, blocking, and slipping hazards
- Removing accumulated toxic dust on surfaces
- Wetting down surfaces to keep toxic dust out of the air
- Using safe lifting techniques

- Maintaining equipment and tools in good repair
- Using personal protective equipment (PPE)

Other safe work practices apply to specific jobs in the workplace and involve specific procedures for accomplishing a job. To develop safe procedures, you conduct a job hazard analysis (JHA). If, during the JHA, you determine that a procedure presents hazards to the worker, you would decide that a training program is needed. We recommend using the JHA as a tool for training your workers in the new procedures. A training program may be essential if your employees are working with highly toxic substances or in dangerous situations.

8. Which of the following would be considered a specific safe work practice?

- a. Maintaining tools in good repair
- b. Testing the atmosphere in a confined space
- c. Safe lifting techniques
- d. Using personal protective equipment

Personal Protective Equipment (PPE)

Using personal protective equipment is a very important safe work practice. It's important to remember that, like other administrative controls, the use of PPE does not control the hazard itself, but rather it merely controls exposure to the hazard by setting up a barrier between the employee and the hazard. Use of PPE may also be appropriate for controlling hazards while engineering controls are being installed or work practices developed.

PPE Drawbacks

The limitations and drawbacks of safe work practices also apply to PPE. Employees need training in why the PPE is necessary and how to use and maintain it. It also is important to understand that PPE is designed for specific functions and are not suitable in all situations. For example, no one type of glove or apron will protect against all solvents. To pick the appropriate glove or apron, you should refer to recommendations on the safety data sheets of the chemicals you are using.

Your employees need positive reinforcement and fair, consistent enforcement of the rules governing PPE use. Some employees may resist wearing PPE according to the rules, because some PPE is uncomfortable and puts additional stress on employees, making it unpleasant or difficult for them to work safely. This is a significant drawback, particularly where heat stress is already a factor in the

work environment. An ill-fitting or improperly selected respirator is particularly hazardous, since respirators are used only where other feasible controls have failed to eliminate a hazard.

9. What is the best source of information to help you select the most appropriate personal protective equipment while working with potentially hazardous material?

- a. Secondary label
- b. Supplier invoice
- c. Safety Data Sheet
- d. The inner lining of a glove or apron

Interim Measures

When a hazard is recognized, the preferred correction or control cannot always be accomplished immediately. However, in virtually all situations, interim measures can be taken to eliminate or reduce worker risk. These can range from taping down wires that pose a tripping hazard to actually shutting down an operation temporarily.

The importance of taking these interim protective actions cannot be overemphasized. There is no way to predict when a hazard will cause serious harm, and no justification to continue exposing workers unnecessarily to risk. By the way, OSHA believes there is always some kind of interim measure that can be used to temporarily abate a hazard.

10. What is OSHA's belief about the use of interim measures to control hazards?

- a. They should not be used
- b. They are always available
- c. Employers must always use them
- d. Some interim measures are not useful

Maintenance Strategies to Control Hazards

There are two general types of maintenance processes needed to control hazards:

- Preventive maintenance to make sure equipment and machinery operates safely and smoothly.

- Corrective maintenance to make sure equipment and machinery gets back into safe operation quickly.

Hazard Tracking Procedures

An essential part of any day-to-day safety and health effort is the correction of hazards that occur in spite of your overall prevention and control program. Documenting these corrections is equally important, particularly for larger sites.

Documentation is important because:

- It keeps management and safety staff aware of the status of long-term correction items;
- It provides a record of what occurred, should the hazard reappear at a later date; and
- It provides timely and accurate information that can be supplied to an employee who reported the hazard.

The hierarchy of controls is the standard system of strategies to effectively eliminate workplace hazards. Remember, the first question to ask when considering ways to eliminate a hazard is, "can we apply engineering controls?" You may need to use a combination of strategies to effectively eliminate the hazard. Whatever it takes, do it. You are not just saving a life... you are saving a father, a mother, a son, or a daughter... you are saving a family. It's worth the effort.

11. What strategy can be used to make sure equipment and machinery operate safely and smoothly?

- a. Emergency maintenance
- b. Preventive maintenance
- c. Corrective maintenance
- d. Programmed maintenance

Module 6: Problem Solving

Introduction

Solving safety problems centers around two key strategies: Correcting surface-cause conditions and behaviors and improving root-cause safety management system weaknesses.

- **Correcting surface-cause problems.** It's important to eliminate or at least reduce unsafe behaviors and hazardous workplace conditions that cause or contribute to accidents.
 - Employee, supervisor, and manager behaviors are the most direct observable effects (leading indicators) of safety management system effectiveness. Inappropriate or unsafe employee behaviors, in turn, create hazardous workplace conditions.
 - To understand and correct employee surface-cause behaviors and hazardous conditions, it's important to conduct employee surveys, interviews, observations, and workplace inspections.
- **Improving root-cause problems.** To most effectively eliminate or reduce surface causes, you must dig up and correct their underlying root-cause safety management system weaknesses.
 - To correct the root causes you need to design, develop and deploy an effective safety management system.
 - Improving safety management system policies, programs, plans, processes, procedures, and practices (the 6-Ps) will positively affect what employees think and how they behave in the workplace.

1. To most effectively eliminate or reduce surface causes, you must correct root-cause safety management system ____.

- a. common sense management flaws
- b. design and performance weaknesses
- c. collective leadership weaknesses
- d. leading and lagging indicators

Understanding the Problems

It's very important that management take action to correct OHSMS problems to reduce the risk of injuries and illnesses in the workplace. Most accidents, by far, are caused by inappropriate or unsafe employee thoughts/behaviors. Problems with the physical work environment can also cause injury or illness. Unsafe behaviors indicate that the nature of the problem may reflect employee/manager personal behaviors and performance that increases the probability of injury or illness. Below are tools that we have previously discussed in the course to identify and understand hazardous conditions and unsafe work procedures.

- informal and formal observation
- safety inspection
- Job Hazard Analysis
- accident investigation
- records/reports review

Root cause problems include corporate behavior and performance that lead to increased probability of injury or illness. Unsafe corporate behavior and performance is reflected in poor management vision, attitude, decision-making, and policy direction regarding workplace safety and health. Tools to help identify and understand the root-cause problems associated with surface causes include:

- interviews
- surveys
- records/reports review
- brainstorming
- pareto chart
- fishbone diagram

2. Which of the following tools would be best at uncovering the root causes of workplace hazards and unsafe behaviors?

- a. Fishbone Diagram
- b. Observation
- c. Checklist
- d. Safety Inspection

Important Questions

To better understand the problem you are trying to solve, you need to answer some very basic questions.

What is the Nature of the Problem?

- Leadership - Are supervisors or managers failing to demonstrate necessary leadership skills?
- Management - Do managers lack the ability to design and/or carry out management processes?
- Relationships - Are there unproductive or harmful working relationships between employees?
- Process - Is there a failure to design or carry out safety processes and procedures?
- Environment - Is the physical or psychosocial environment healthful to employees? Is some form of distress (due to factors outside the control of the employee) causing injury or illness?
- Equipment - Are tools, equipment, and machinery reliable? Is there a high rate of failure?
- Material - Are materials used in production or service processes hazardous in some way?

What is the Scope of the Problem?

- Personal: Affects/within yourself, or between yourself and another?
- Interpersonal: Affects/within another or between two persons?
- Group: Affects/within a group or between groups?

- Corporate: Affects/within the company?
- Industry: Affects/within another company (supplier, distributor)?

Is There REALLY a Problem?

- Gap Analysis- Is there a gap between what we want and what we have? You need to be able to communicate what that gap is.
- Get agreement - is everyone sold on the problem? It's important that everyone involved in solving the problem can agree with the problem and solution or can at least live with it; that's called "consensus."

3. Which of the following will help you determine if there really is a safety problem?

- Determine the nature of the problem
- Determine the scope of the problem
- Conduct environmental analysis
- Conduct gap analysis

Cause-Effect Analysis

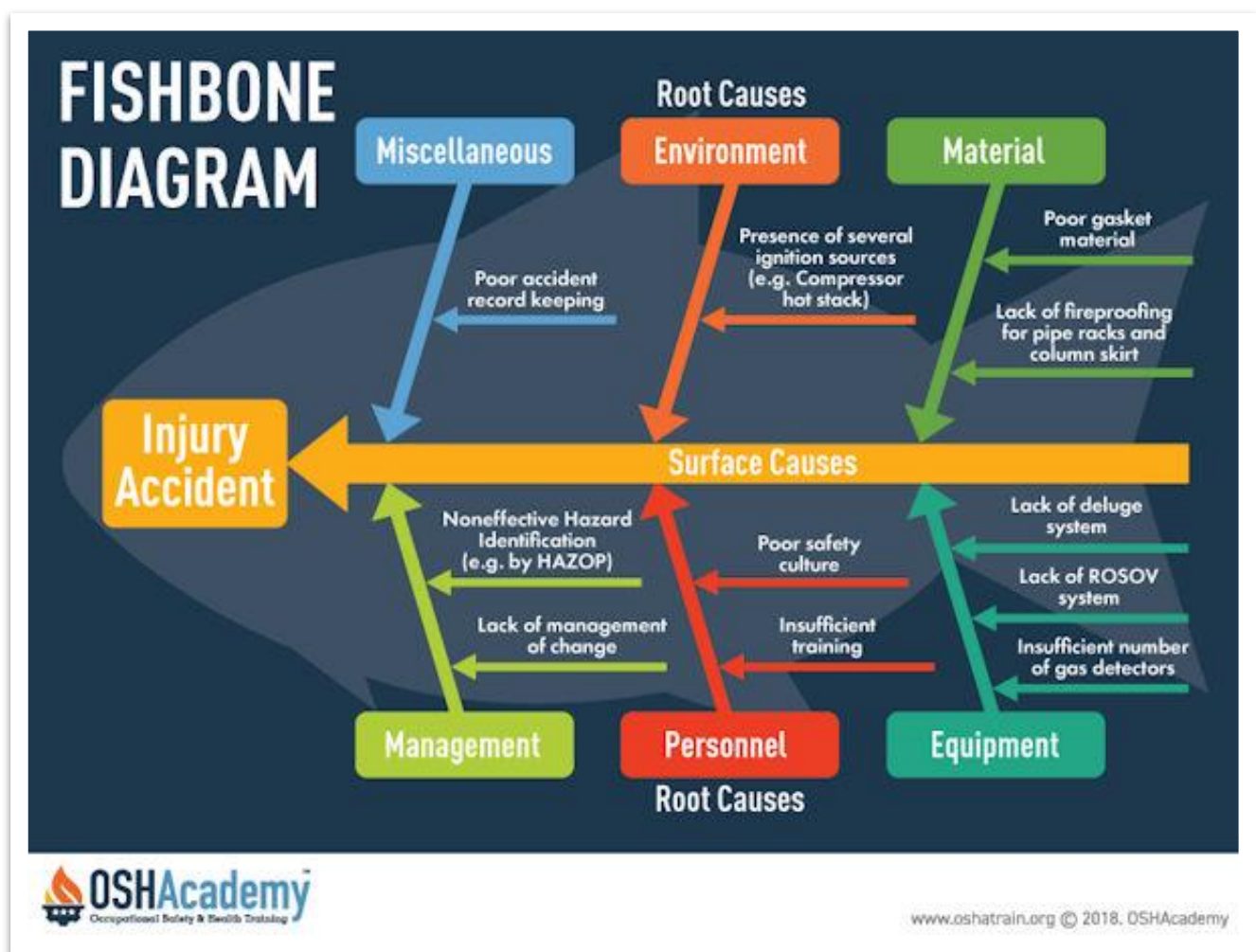
One technique used in conducting root cause analysis when hazards are identified or when incidents/accidents occur is called Cause-Effect Analysis. For every effect there is a cause. Starting with the accident, we analyze each event leading up to the accident to identify "effects." Then we attempt to uncover the cause for each event. Every "effect" is the result of a "cause." It's important to understand that each effect is, at the same time, the cause for another effect. A single effect by itself can generate a completely new cause-effect branch. The table to the right represents only one branch of many possible branches.

Initial Cause	Top management thinking	"We can't afford safety training."
Effect Cause	Safety management system design factors	No money is devoted for safety training lockout/tagout (LOTO) procedures.
Effect Cause	Safety management system performance factors	Lockout/tagout training is not properly conducted.
Effect Cause	Bob's (the victim) previous experience, education, and training	Employees do not know about or how to perform LOTO. Only a few know how to do LOTO.
Effect Cause	Bob's beliefs of the victim	"If management doesn't think LOTO is needed, who am I to disagree?"
Effect Cause	Bob's thoughts and feelings of the victim	"I haven't been hurt yet. I won't get hurt this time."
Effect Cause	Hazardous conditions and employee exposure	Exposure to 240 VAC live circuit during task.
Final Effect	Accident	Bob is electrocuted as he works with a live circuit.

As you can see, the first set of questions get at the surface cause(s) related to an actual or potential accident. Once we know what directly caused the injury or illness, we begin to ask why to arrive at root causes. Each time a why question is asked, a deeper root cause is uncovered.

Something's Fishy Here

One of the primary tools in cause-effect analysis is the **Fishbone Diagram** or **Cause and Effect Diagram**. Basically, it's just a mind map using a different form. The diagram on the next page illustrates this. The "Effect" describes the problem. Possible causes are listed under one of several categories that you determine. Generally, these categories might be people, materials, equipment, environment, methods, or procedures.



4. When conducting any kind of analysis, it's important to remember that ____.

- a. for every cause, there is a result
- b. for every effect, there is a cause
- c. for every accident, there is a careless act
- d. for every injury, there is an employee error

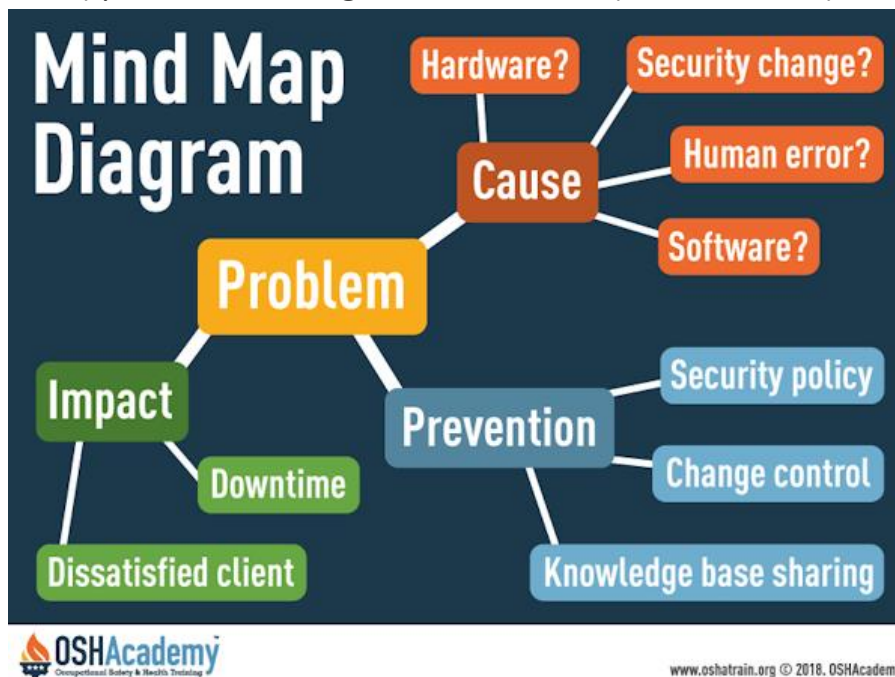
Mind Mapping - Another tool to identify problems

Mind Mapping, originated by Tony Buzan, is nothing more than "instantaneous non-linear cognitive deduction utilizing spatial forms in a two-dimensional plane." (huh?) Seriously, mind mapping is merely drawing circles and lines to help you quickly think about and categorize ideas, problems, concepts, subjects, and just about anything else. Mind mapping is successful because it takes advantage of the brain's natural ability to categorize ideas in a rapid, but rather unorganized manner.

Look at the mind map below and follow these steps:

- At the center, we write the problem.
- Think about the factors that are the more obvious causes for the problem. (This works best by letting your subconscious do the work while you watch TV or work on another project)

- Look at each factor listed and ask why that particular cause exists. After a while (minutes to hours) you will build a diagram similar in form (but not content) to the one below.



Using this technique, you'll be able to take any topic, project, or problem and quickly determine related categories, processes, procedures, etc. Once the mind map is complete, it is merely a matter of reorganizing the information into the more common "outline" format.

5. Which technique is successful because it takes advantage of the brain's natural ability to categorize ideas in a rapid, but rather unorganized manner?

- a. Analysis
- b. Brainstorming
- c. Mind Mapping
- d. Checklists

Brainstorming

You are probably familiar with this problem solving technique. Brainstorming can be used by individuals or groups quite successfully to quickly develop a list of possible solutions to problems. Below are six basic and unalterable rules to the group process of brainstorming that set it apart from other problem-solving procedures.

- Define the issue. Make sure everyone is clear on the problem you are going to brainstorm.
- Critical non-judgment. Defer judgment on any idea that is expressed. This even includes encouraging comments to others or qualifying phrases attached to your own suggestions.
- Organized chaos. The session should be as freewheeling as possible, with each person voicing whatever ideas come to mind - - no holds barred. Ideas may be expressed in rapid, machine-gun, fashion. Don't limit the creativity.
- Similar originality. Participants are encouraged to hitchhike or piggyback on the ideas of others. When one person's suggestion sparks an idea by another, it should be instantly expressed. Lots of "ah-ha's"...
- Quantity, not quality. The more ideas the better. The goal of brainstorming is to get as many ideas as possible. Evaluation and elimination can be accomplished later.
- Brief summary statements. Don't go into great detailed explanations of your idea. You want the recorder to be able to have time to write down all ideas as team members think of them.

6. This problem-solving technique can be used by individuals or groups quite successfully to quickly develop a list of possible solutions to problems.

- a. Mindmelding
- b. Mind Mapping
- c. 5-Why Analysis
- d. Brainstorming

Mindmelding

Mindmelding is just another way to gather a large number of ideas by taking advantage of the creative minds of many people. Here's the process:

1. On a piece of scratch paper, each person in the group writes what they consider a major problem.
2. Once each person has completed writing the problem statement, they pass it to the person on their right.

3. Each person then reads the problem statement they have received from the person to their left. As quickly as they can, they write out what they think might be one solution to the problem, and then pass the paper to the person on their right.
4. Step three is repeated as many times as necessary until each person has received their original problem statement with possible solutions listed.

Using these techniques to conduct cause analysis will help you uncover those root causes that contributed to an incident or accident. If you improve the system as a result of your analysis, long term benefits will result. You are now saving or making money for your organization... safety's bottom line.

7. Which problem-solving technique has each person in a group write a problem statement, then pass it around to members who each write a solution statement?

- a. Mindmelding
- b. Mind Mapping
- c. 5-Why Analysis
- d. Brainstorming

Module 7: Effective Recommendations Sell Safety

Introduction

Once you have developed solutions that describe engineering and/or administrative controls to eliminate or reduce injuries/illnesses, the next task is to convince or persuade management to make changes: that's the goal of the good recommendation. You may perceive corrective actions as immediate needs, but management may see them as planned events. Your challenge is to help them develop informed perceptions.

Most likely, management will understand the importance of taking corrective action and readily agree to your ideas. However, if your management team doesn't quite understand the benefits derived from an aggressive proactive approach to workplace safety, the likelihood of success decreases. If that's the case where you work, the ability to present effective recommendations is all that more important. This module will help you learn how to present "an offer they can't refuse," by emphasizing the long-term bottom-line benefits of the solutions you are recommending.

1. What is the goal of a good safety recommendation?

- a. Lower employee turnover
- b. Persuade management to make changes
- c. Make workers happy
- d. Create a system of techniques

Writing Recommendations

It's important to write effective recommendations so that the decision-maker enough information to make a good decision. To speed up the process and to improve the approval rate, you must learn to anticipate the questions that the decision-maker will ask in order to sign off on the requested change. This being the case, the more pertinent information you can include in the presentation, the more likely the recommendation will be approved. Remember, the primary purpose of a recommendation is to persuade.

To develop effective recommendations, perform the following key steps:

1. Write the problem statement

Based on the work you did in the problem-solving phase, you should be able to write a clear statement of the problem. The decision-maker must be able to clearly understand exactly what the problem is. Be sure you describe:

- **Surface causes:** Are the hazardous conditions and related unsafe behaviors that have directly or indirectly caused an accident. Hazardous conditions and unsafe behaviors also represent the final outputs or effects of a safety management system (SMS) that may have somehow failed.
- **Root causes:** Are the inadequate or missing system elements such as resources, programs, plans, policies, processes, procedures, rules that contribute to the hazardous conditions and unsafe behaviors? These point to even deeper root causes in safety management system structure, design and development. Examples of problem statements:
 - Condition: “Five ladders in the warehouse are defective.”
 - Behavior: “Most employees at the worksite are not reporting injuries to supervisors.”
 - System: “The safety training plan does not include lockout/tagout training.”

2. Which of the following represents failures in the design, development and deployment of the safety management system?

- a. Root causes
- b. Surface causes
- c. Remote causes
- d. Conditional causes

2. Describe the history of the problem.

- Describe the history of previous hazards and system failures. A history of past hazards, behaviors, or accidents indicates an increased probability that a future accident may occur. An established trend is a strong indicator of SMS weaknesses. Of course, the lack of a previous similar condition, incident or accident does not mean it won't negatively impact the company in the future: It could be that you've just been lucky so far. Note: To establish a valid trend, you'll need to analyze data from at least seven points in time: could be seven days, weeks, months, years. It all depends on the kind of data you are analyzing. For instance, if you are

trying to establish a trend related to the number of strains and sprains, depending on how often those injuries occur, you might have to look at seven months or seven years.

- Describe how past similar hazards affected direct (budgeted, insured) accident costs. Direct costs of accidents include workers compensation premiums and miscellaneous medical expenses. The employer will pay this (on average) over a number of years in increased workers compensation premiums. It's no different than car insurance...you have an accident, and it's your fault (compensable), your insurance goes up.
- Describe how past similar hazards have affected indirect costs. Indirect costs are immediate costs that come right out of the corporate pocketbook. Indirect costs include additional training, replacement workers, lost production (closing the plant down), increased supervision, etc.

3. Immediate accident costs that come right out of the corporate pocketbook are called

_____.

- a. Surface accident costs
- b. Direct accident costs
- c. Indirect accident costs
- d. Conditional accident costs

3. State the solution options that would correct the problem.

It's important to present options from which the decision-maker may choose. Options give the decision-maker greater control by allowing him or her to choose from a number of solutions rather than being stuck with a go/no-go decision. Ultimately, when options are given, the likelihood something will get done increases. When giving options:

- Make sure they somehow eliminate or at least reduce the hazards and behaviors.
- Make sure they somehow improve resources, programs, policies, plans, processes, procedures, practices, rules, forms, documents, or reports.
- Recommend at least two (ideally three) solutions.
 - Option 1: What can be done if money is no constraint?

- Option 2: What can be done if money is limited but available?
- Option 3: What can be done if money is a make/break consideration?
- Briefly list low/high cost solutions that eliminate the problem now/soon.
- Briefly list low/high cost solutions that reduce the problem now/soon.
- Briefly list the advantages and disadvantages of each solution.

4. By giving decision-makers options, they will more likely approve your recommendations because they have ____.

- a. the ability to choose least expensive solutions
- b. greater control over the process
- c. more authority to make decisions
- d. an opportunity to demonstrate leadership

4. Describe the consequences.

- Describe the type of accident that might result from inaction. To help educate decision-makers it's important to describe the type of accident that might result if corrective actions aren't taken. The accident designations below are useful in describing the types of accidents that might result if hazards are not corrected. You can see a list of accident types in [Course 702 Accident Investigation, Module 1](#).
- Describe other natural consequences of management's decision. The natural consequences are those that occur automatically. Inaction might increase the cost of doing business (CODB) due to increased injuries or illness, and lower morale, productivity, quality, and profits. Management action will likely reduce the CODB because employees aren't getting hurt or sick, and morale, productivity, quality and profits remain high.
- Describe the estimated insured and uninsured costs if corrective action is not taken. According to the National Safety Council, the economic impact of these fatal and nonfatal unintentional injuries amounted to slightly less than \$700 billion in 2009.

- Describe the system consequences of inaction. System consequences usually originate outside the organization. Inaction might result in OSHA penalties, increased workers compensation, loss of contracts. Action is likely to result in lower penalties, workers compensation, and a higher probability of winning contracts.
- **Estimate the "return on investment" (ROI).** Expressing the "cost" of taking corrective action and making system improvements is better expressed as an "investment" because it implies that the employer will realize a financial return if corrective actions are taken.

Let's say the investment needed to correct a hazardous condition is \$4,000. Let's also assume that the potential direct and indirect accident costs to the company may total \$36,000 if the employer takes no action. You can calculate the ROI by dividing the \$36,000 in accident costs by the \$4,000 investment to get the ratio of 9/1. To determine the ROI as a percentage, multiply that result by 100 to arrive at an ROI of 900%.

$$\begin{aligned} (\text{COST} \div \text{INVESTMENT}) \times 100 &= \% \text{ ROI} \\ (\$36,000 \div \$4,000) \times 100 &= 900\% \text{ ROI} \end{aligned}$$

- **Estimate the payback period.** Management may also want to know how quickly the investment will pay for itself: what the "payback period" is. Just divide \$36,000 by 12 months and you come up with \$3,000 per month in potential accident costs. Since the investment is \$4,000, the investment will be paid back in a little more than five weeks. After that, we may assume that the corrective actions and improvements are actually saving the company a substantial amount of money. Now that's talking the bottom line!

$$\begin{aligned} \text{INVESTMENT} \div (\text{COST} \div \text{MONTHS}) &= \# \text{ MONTHS} \\ \$4,000 \div (\$36,000 \div 12 \text{ MONTHS}) &= 1.33 \text{ MONTHS} \end{aligned}$$

5. To help the decision-maker see that the cost of corrective actions and improvements will lead to eventual savings, express the costs as ____.

- a necessary fee
- an expenditure
- an investment
- just the cost of doing business

5. Determine the risk.

“Recognized” Hazards

It's important that decision-makers understand the risk, or the possibility that an accident will occur, if action isn't taken to correct the hazard. Why is it important to determine the risk? The higher the risk, the stronger your argument needs to be.

Let's take a look at the "Risk Equation" below that you can use to determine risk:

$$R = E \times P \times S$$

Risk Equation Variables

- **Risk (R)** is a function of exposure, probability, and severity. When one or multiple of those variables increase, there is a higher level of risk of illness, injury, or fatality.
- **Exposure (E)** is determined by considering the frequency and duration of physical/environmental exposure to a hazard.
- **Probability (P)** describes how likely exposure to a danger zone will result in an injury (unlikely, likely, highly likely).
- **Severity (S)** describes how serious the injury or illness might be (minor, major, fatality).

Risk Equation Example

Open this [Risk Worksheet](#) to follow along.

Let's say you conduct a risk assessment for a task lifting heavy boxes. Two untrained older employees lift 80-pound boxes at least 10 times a day. They have to individually carry the boxes 50 ft to a loading dock. Using the Risk Worksheet, we can determine a risk score for the task that will help convince management to provide material handling devices or at least training on effective lifting techniques.

- **Exposure (E).** First, we need to determine exposure. This task is considered to be performed continuously, or many times a day. The rating will be “200” in this example. We will double the score to “400” since two employees perform the task.
- **Probability (P).** We can estimate that an injury will quite possibly occur. Other employees have suffered injuries performing this task. Since the employees are untrained and in their

50s, the likelihood of an injury increases. In this example we will assign a probability rating of 10. Since we doubled the exposure rating, we do not have to double the probability rating.

- **Severity (S).** This task will most likely result in a serious injury to the back that could be disabling. We'll give this task a severity rating of 20.
- **Risk (R).** Multiplying Exposure x Probability x Severity (400 x 10 x 20), we arrive at a risk score of 80,000. Wow! That is a high score and it means that a serious injury is extremely likely at any time.

6. Which of the following terms describes how serious an injury or illness might be?

- a. Severity
- b. Probability
- c. Potential
- d. Possibility

6. Determine motivation

What motivates employers?

Throughout the recommendation, think about what objections and motivations the decision-maker might have. Be sure to include counter-arguments to objections by addressing the three "imperatives" below where they most logically apply.

As discussed in OSHAcademy Course 700, employers are motivated to approve your recommendation primarily to meet one of the following safety obligations:

- The Legal Imperative. This describes the employer's legal duty to comply with occupational safety and health standards. When this is the primary motivation, safety is considered just another cost of doing business (CODB) that may drain the corporate budget. Unfortunately, the employer will do only what is required by law...probably not much more. The employer's primary goals are to:
 - comply with OSHA standards
 - to "stay out of trouble" with OSHA

- avoid OSHA penalties
- The Fiscal Imperative. The employer is obligated to corporate stakeholders to operate the business in a financially prudent manner. In the private sector, this means "operating at a profit." In the public sector, this means "operating within budget."
- The Social Imperative. In the best-case situation, the employer feels a strong obligation to each employee, the community, and society in general to support and protect the welfare of all employees... its "corporate family." Safety is perceived as a core corporate value, not open to negotiation.

If your employer is "doing safety" primarily to meet legal requirements, and nothing more, to overcome objections you'll need to emphasize the legal benefits. Research indicates most employers are motivated primarily by the need to fulfill their fiscal responsibilities, so don't be surprised if management requires a cost/benefit analysis. If the employer makes a commitment to safety primarily to fulfill the social imperative, management is likely to approve your recommendation no matter what the investment might be. Just remember, you need to understand what motivates the decision-maker to increase your chances of getting your recommendations approved. You need to know which "buttons" to push.

7. When presenting your recommendations to a decision-maker, what should you know about this person?

- a. When not to ask
- b. What his or her price is
- c. Who his or her friends are
- d. What motivates his or her decisions

Management Messages

When management understands the importance of taking corrective action and making safety program improvements, and acts on recommendations consistently, it sends a very positive message about leadership to the workforce. It tells workers the employer cares for and values every employee! When this message is clearly sent, employees are far more likely to put out the extra effort for the company which benefits everyone.

When management ignores or does not set out to correct hazards in the work place, a negative message is sent to the workforce: a message that infers a lack of care and value for employees. Through word and deed, management convinces workers that corporate profits take priority over employee welfare. Managers communicate that they are willing to take an acceptable level of risk as though the employee were more a "unit of labor" than a valuable human resource.

A Strong Recommendation Doesn't Have to be Complicated

Right now, you might be rather intimidated by all this, but take heart; an effective recommendation doesn't have to meet all of the criteria above, and it doesn't have to be a massive document.

Here's an example of an excellent recommendation submitted by a course graduate, Dianna G:

1) Problem: The guard rail in the warehouse has deteriorated to a point that it is unable to support any weight on it.

2) History: We had an incident on 6/13/06 where Joe Annon almost fell down the 10 steps because the guard rail did not support his weight. He fortunately caught himself before falling. We had a second near miss incident on 9/18/06 when Jane Doe tripped going up the stairs and grabbed for the rail which did not support her. Again, fortunately she caught herself before falling.

3) Options to correct problem:

1. We have attempted to tighten and brace the rail but it continues to work itself loose. We took bids to replace the rail and the bids ranged from a high of \$3,200 to a low bid of \$1,500. We believe the xyz brand for \$2,000 will prove to be the best material for our facility. The disadvantage to the lowest bid of \$1,500 was it would not be guaranteed for outside weather conditions.

2. We budgeted "x" for off-site training classes and have secured a source for on-line no-cost training through OSHA that could save "X" dollars that could be applied toward part of the cost of the guard rail.

4) Cost/Benefit:

ROI. Average cost of a severe injury is \$9,700 which is very possible if one of our employees should fall from the second story of the warehouse to the concrete pad below.

The estimated indirect cost is \$17,500. Total accident cost is estimated to be \$27,200. ROI will be approximately 1,360 percent!

Payback Period. I estimate that the probability of an accident occurring within the next two years as a result of this hazard is very high. Therefore, the payback period is based on 24 months. Our cost for corrective action is \$2,000 and the payback period would, therefore, be less than 2 months (\$1,133/month.).

Writing effective recommendations gets easier as you gain experience. It's the job of the person making the recommendation to "educate up" so that management understands the importance of making the right decision. Just remember, if you know what motivates your manager and you push the right buttons, you'll get the results you want.

8. What is the message when management consistently ignores safety recommendations?

- a. Corporate profits take priority over employee welfare
- b. Safety recommendations are not adequately stated
- c. Profit margins are just not good enough
- d. Safety recommendations don't affect the bottom line