

# **Field Safety Considerations and its Design Implications — Introduction to Workplace Health and Safety**

# Basic Principles of Accident Prevention



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## Learning Objectives

- Learn and apply **legislative** requirements, industry standards, and best practices in a variety of workplaces.
- Apply **risk management** methods to identify, anticipate, manage, and control workplace hazards.
- Collect and merge data to identify the current **safety issues** within the workplace.
- Have a solid understanding of **health and safety management** at workplace and able to pass along sufficient information to others in potential risk.
- Apply solutions, prevention and basic assessments to the **hazards** created by other coworkers.
- Practice **safety procedures** and employ ethical standards in all aspects at workplace.

## History of Workplace Injuries and Fatalities

- ☐ The safety of workers is a critical priority for employers, often taking precedence over production and quality.
- ☐ The safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management.



## History of Workplace Injuries and Fatalities

- ❑ Creating a positive culture for safety helps workers to understand and follow good safety habits.
- ❑ Thinking safety and acting accordingly has been effective for many years and the results are significantly different from the early years of industrial developments.

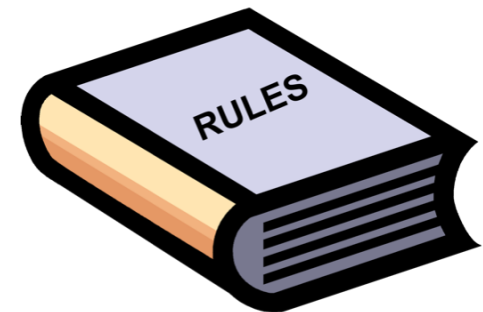


*Ref: Signs of workplace safety culture, Annemarie communicates insurance*

## History of Workplace Injuries and Fatalities

❑ However, there are still reports of injuries and fatalities throughout workplaces around the world. While unsafe conditions and processes contribute to these injuries, some of these are caused due to human errors. That is why the safety culture is extremely important in preventing injuries and fatalities.

❑ Employers and workers are required to follow the occupational health and safety regulations. The duties of employers and workers are detailed in the health and safety regulations.



## History of Workplace Injuries and Fatalities

- According to statistics results, men are most likely to be injured in workplaces. But does this mean that any type of job put men in danger?
- Clearly, the answer is No as it seems that there are more men working in hazardous work environments than women.
- Therefore, the chance of men getting injured in those environments is higher.
- What other reasons can cause men to have a higher injury rates?



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## History of Workplace Injuries and Fatalities

- Individual Malaysian provinces have different injury rates depending on the resources and the type of jobs there.
- Which provinces do you think have the highest injury rates?



## **History of Workplace Injuries and Fatalities**

- **The DOSH report indicates that provinces with higher populations such as Johor, N. Sembilan, Perak, Sarawak dan Selangor have the most injuries each year.**

**For the mentioned sectors. Manufacturing had the most injury rates followed by Agriculture, Forestry, Logging and Fishery and Construction**

## Workplace Hazards

Hazard is a potential source of danger that can result in death or injuries when it is active.



Ergonomic

Psychosocial



Physical



Chemical

Biological



## Workplace Hazards – Ergonomics

This is a common type that occurs due to improper performance of conducting work duties such as repetitive movement, lifting, sitting, improper set up of work stations, etc.



## Workplace Hazards – Chemical Hazards

Any chemical source such as release of chemical materials with toxic properties.



## Workplace Hazards – Psychosocial

Workplace violence, harassment, stress, etc. are considered as hazards with psychological impacts on workers

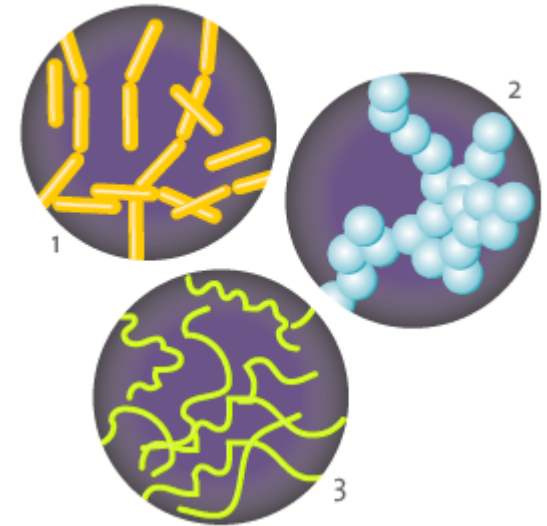


## Workplace Hazards – Biological

Any biological source that may cause illnesses or other effects on the body such as viruses, insects, animals, bacteria, plants, etc.



Bakterien



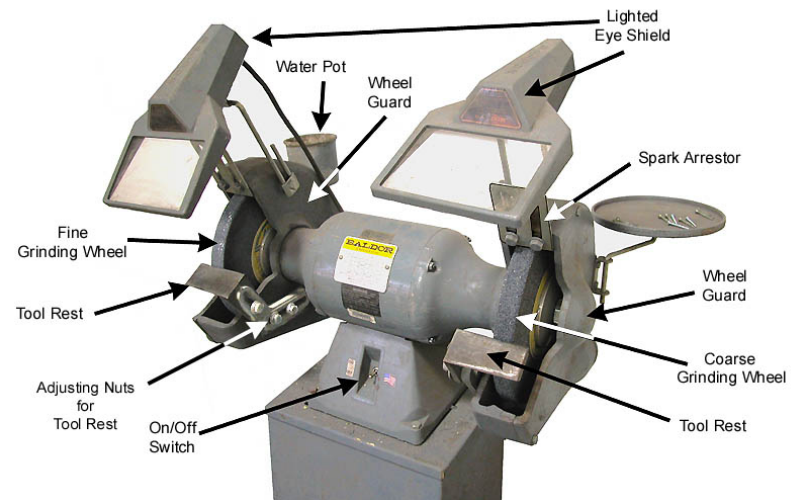
## Workplace Hazards – Physical Hazards

Hazards such as noise, radiation, high pressure or vacuum, etc are considered as physical type of hazards.



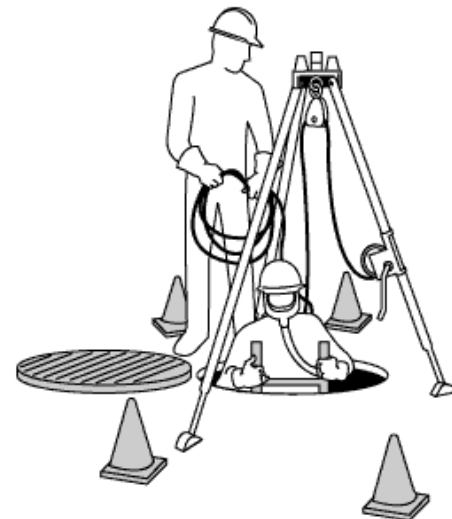
## Workplace Hazards - Physical Hazards

Inappropriate machine guarding, slipping and tripping, breakdowns, equipment malfunction are categorized as safety hazards in workplaces.



## Workplace Hazards - Physical Hazards

High risk activities are types of job that need special attention as in case of an occurrence, the results may be fatal or serious injuries. They normally need special training and/or permit.



## Ergonomic Hazards

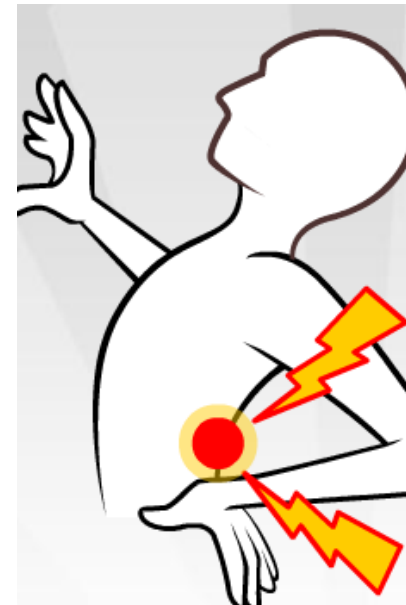
- **Ergonomic hazards occur when the type of work, body positions and working conditions put strain on the worker's body.**
- **These damages may not be effective immediately and can cause injuries over the time.**
- **Short term injuries may result in muscle pain and sore muscles however, the long term exposure may cause serious health problems.**



*Ref: Training solutions. Em powers, copyright @2010*

## Ergonomic Hazards

- **Examples of ergonomic Hazards are:**
  - **Improperly adjusted workstations and chairs**
  - **Frequent lifting**
  - **Poor posture**
  - **Awkward movements such as shaking legs, especially if they are repetitive**
  - **Repeating the same movements over and over**
  - **Using excessive force**
  - **Vibration**



*Ref: Training solutions. Em powers, copyright @2010*

## Hazard Control – Ergonomic

- **Preventive solutions**
  - **Regardless of whether or not workers have reported Musculoskeletal Disorders (MSD\_ symptoms, or whether or not they have filed SOCSO claims, MSD prevention needs to be a key part of a workplace health and safety program. MSD risk factors should be handled like any other workplace hazard.**

## Hazard Control – Ergonomic

### Employers should:

- Advise and train workers about the MSD risk factors in their job and in the workplace
- Encourage workers to participate in the health and safety program through early reporting of MSD symptoms or concerns
- Identify and assess job related MSD risk factors
- Put in place controls to reduce workers' exposure to MSD risk factors, including design considerations
- Follow-up to make sure preventive measures are working

## Hazard Control – Ergonomic

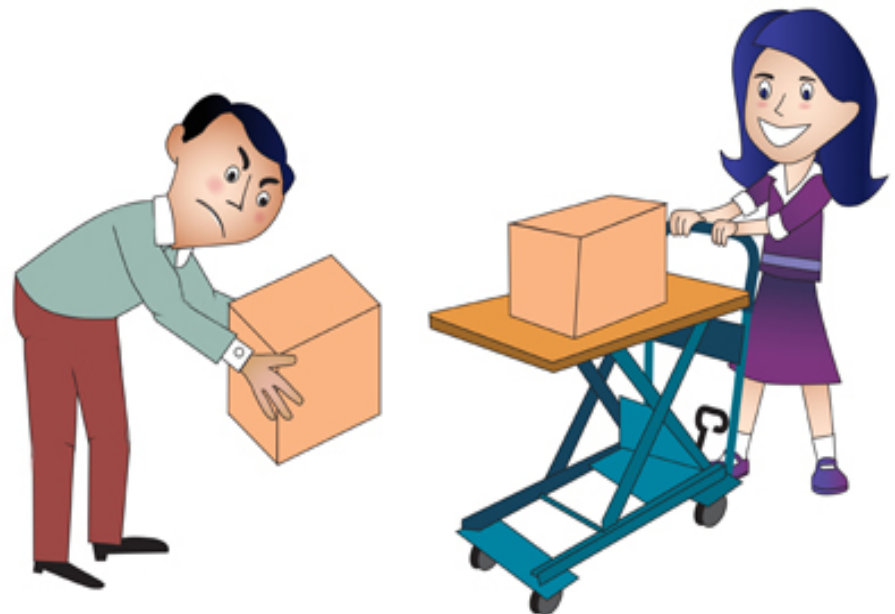
**What engineering designs would you consider to reduce MSDs?**



*Ref: Avoid MSDs at  
work,  
[www.safework.co.uk](http://www.safework.co.uk)*

## Hazard Control – Ergonomic

- Designs as simple as the raising cart in the figure, can simply reduce the risks of MSD.
- It is important to ensure equipment maintenance can be conducted in an ergonomically friendly way, without excessive bending, reaching, etc.



*Ref: Prevention of MSDs,  
[www.riskmanagement365.com](http://www.riskmanagement365.com)*

## Chemical Hazards

- Chemical hazards in the workplaces will vary by the type of industry.
- Some most common hazards at workplaces are:
  - Liquids like cleaning products, paints, acids, solvents especially chemicals in an unlabeled container (warning sign!)
  - Vapors and fumes, for instance those that come from welding or exposure to solvents
  - Gases like acetylene, propane, carbon monoxide and helium
  - Flammable materials like gasoline, solvents and explosive chemicals.



## Chemical Hazards – Carbon Monoxide

- **Carbon monoxide**
  - Carbon monoxide is a tasteless, odorless and colorless gas that is highly toxic to humans.
- **Locations**
  - This hazard may occur while breathing from an air compressor source.
  - The air compressor contains air lubricants that may break down in high temperature and produce carbon monoxide.
  - In some cases, the exhaust air of a diesel engine or any nearby source might enter the compressor.



Signs of carbon monoxide poisoning

*Ref: "Hogg Mechanical Industry", Carbon Monoxide Poisoning.*

## Hazard Control – Carbon Monoxide

- **Precautions**
  - The compressor must be connected to clean outdoor source for the intake air. The compressor must be used and maintained according to the manufacturer's instructions.
  - Ensure that whenever potential sources of CO are introduced (diesel fork trucks, generators, furnaces, natural gas dryers, etc. ) that the design accounts for the potential of these fuel burning devices to accumulate CO and adequate ventilation is provided.
  - The carbon monoxide level must be monitored using detectors.

## Chemical Hazards – Asbestos

- **Asbestos is a naturally occurring silicate mineral that can be separated into fibers considered to be a health hazard.**
- **Location**
  - **Asbestos may be found in these building locations:**
    - **Corrugated roof panels that have substances of asbestos cement**
    - **Some paints and textured coatings**
    - **Fire protection and structural steel**
    - **Pipes, water tanks and gutters**
    - **Insulations - thermal and acoustic**

## Hazard Control – Asbestos

- **Precautions**
  - **Ensure that all asbestos containing materials are identified and workers are informed**
  - **Remediation must be done by qualified workers**
  - **Testing must be conducted to confirm the presence or absence of asbestos prior to disturbing the area. This is a regulatory requirement in the Ontario construction regulations.**
  - **Proper PPE such as protective clothing (chemical suits, gloves, hoods, respirators, etc.) must be available.**

## Chemical Hazards – Compressed Gases

- **Compressed gases**
  - There are many products available as compressed gases that contain gases and mixture of gases in a pressure cylinder.
- There are three forms of compressed gases:
  - Dissolved
  - Liquefied
  - Non-liquefied
- **Dissolved**
  - The most common gas for this type is acetylene which is known to be a very unstable gas in terms of its properties.
  - Acetylene can be exploded even at atmospheric pressure. Therefore it is normally used and stored in high pressure gas cylinders.



## Chemical Hazards – Compressed Gases

- **Liquefied**
  - For liquefied, initially the cylinder is almost full of liquid, and gas fills the space above the liquid. As gas is removed from the cylinder, enough liquid evaporates to replace it, keeping the pressure in the cylinder constant. Anhydrous ammonia, chlorine, propane, nitrous oxide and carbon dioxide are examples of liquefied gases.
  - Health hazards of compressed gasses, in some gas species, the contact between the skin or eye and liquefied gases in liquid form can freeze the tissue and result in a burn-like injury.

## Chemical Hazards – Compressed Gases

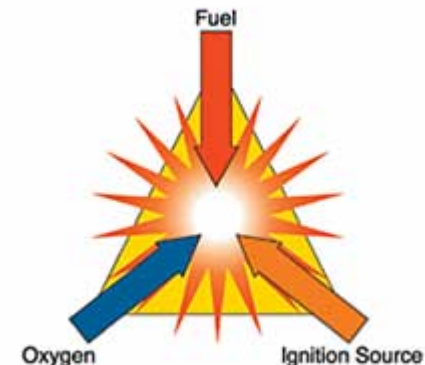
- **Non-liquefied**
  - Gases such as oxygen and nitrogen that do not become liquid at normal temperature are non-liquefied compressed gases.
- **Pressure hazards of compressed gases**
  - Due to the high pressure of the cylinder, the gas can be released quickly by either opening the valve or due to a broken valve.
  - This might even occur at lower pressure as well.
- **Health hazards**
  - Health hazards associated with compressed gasses can vary depending on the gas type, area of exposure (eye, skin, inhalation, etc.), concentration and the length of exposure.

## Chemical Hazards – Compressed Gases

- **Flammable gasses**
  - Flammable gasses can burn and explode in some certain conditions.
  - Generally, the concentration of gas in air must be lower than its flammable range to be safe from any incidents.
  - For gasses within the flammable range, any ignition source in workplace such as open flame, a spark and even hot surfaces can result in tragedy.
  - In some cases, there is no need of any ignition source as auto-ignition temperature of a gas can be minimum when the gas self-ignites itself.

## Chemical Hazards – Compressed Gases

- It is highly recommended that the area with compressed gases is away from any ignition source or the flammable range and concentration of the gas is monitored.
- Some gases have very low auto-ignition temperatures. For example, phosphine's auto-ignition temperature of 100°C (212°F) is low enough that it could be ignited by a steam pipe or a lit light bulb. Some compressed gases, such as silane and diborane, are pyrophoric - they can ignite spontaneously in air.



## Chemical Hazards – Compressed Gases

- Flash-back can occur with flammable gases. Many flammable compressed gases are heavier than air.
- If a cylinder leaks in a poorly ventilated area, these gases can settle and collect in sewers, pits, trenches, basements or other low areas. The gas trail can spread far from the cylinder. If the gas trail contacts an ignition source, the fire produced can flash back to the cylinder.



## Chemical Hazards – Compressed Gases

- **Oxidizing gasses**
  - **Oxidizing gases include any gases containing oxygen at higher than atmospheric concentrations (above 23-25 percent), nitrogen oxides, and halogen gases such as chlorine and fluorine.**
  - **These gases can react rapidly and fatally with the following gasses:**
    - **Organic (carbon-containing) substances such as most flammable gases, flammable and combustible liquids, oils, greases, many plastics and fabrics**
    - **Finely-divided metals**
    - **Other oxidizable substances such as hydrazine, hydrogen, hydrides, sulphur or sulphur compounds, silicon and ammonia or ammonia compounds**

## Chemical Hazards – Compressed Gases

- **Dangerously reactive gasses**
  - Some pure compressed gases are chemically unstable and in case of exposure to a minimal temperature and/or pressure increase, they may go through some chemical reactions.
  - There is a high possibility that these reactions will result in explosion and other dangerous hazards such as chemical substance.
  - Some of the common dangerously reactive gases are acetylene, 1,3-butadiene, methyl acetylene, vinyl chloride, tetrafluoroethylene and vinyl fluoride.



## Chemical Hazards – Compressed Gases

- **Corrosive materials**
  - Corrosive materials can attack the body with a single touch by destroying the skin layers.
  - They immediately show their effects after exposure.
  - They might be hazardous in other ways too, depending on the particular corrosive material.
  - Acids and bases are considered the very commonly known corrosive materials.
  - Common acids include hydrochloric acid, sulfuric acid, nitric acid, chromic acid, acetic acid and hydrofluoric acid.
  - Common bases are ammonium hydroxide, potassium hydroxide (caustic potash) and sodium hydroxide (caustic soda).



## Chemical Hazards – Organic Peroxide

- **Organic peroxide**
  - An organic peroxide is any carbon containing organic material with two oxygen atoms compounded.
  - Organic peroxides can be severe fire and explosion hazards.
- **Hazards**
  - The main hazard related to organic peroxides are fire and explosion.
  - Organic peroxides may also be toxic or corrosive.

## Chemical Hazards – Organic Peroxide

- The amount of exposure, the area of exposure and type of exposure are playing important roles in determining a possible body harm.
- Corrosive organic peroxides can also attack and destroy metals.



## Chemical Hazards – Organic Peroxide

- **Organic peroxide**
  - **Usage**
    - **Plastics and rubber industries are the main users of organic peroxides.**
    - **Organic peroxides and mixtures containing an organic peroxide are used as accelerators, activators, catalysts, cross-linking agents, curing agents, hardeners, initiators and promoters.**
    - **It is important to take the necessary steps to know the materials being used as accelerators, activators, catalysts, etc. for the workers in that sector.**
    - **Using the terms such as accelerators, activators, catalysts, etc. may cause confusion about the hazardous level and serious accidents may occur.**

## Chemical Hazards – Toxic Materials

- **Toxic materials**
  - **Toxic materials are dangerous and most likely to be around the workplace area.**
  - **There are many ways of toxic materials entering the body:**
    - **Skin contact**
    - **Inhalation**
    - **Non-hygienic practices**
  - **Toxic materials can cause serious health effects in an exposed individual.**

## Chemical Hazards – Toxic Materials





**The degree of hazard associated with any toxic material is related to the exact material the person is exposed to, concentration of the material, the route into the body and the amount absorbed by the body.**



*Ref: Hazardous materials, palm beach county,  
[www.pbcgov.com](http://www.pbcgov.com)*

## Chemical Hazards – Toxic Materials

- Toxic materials are classified as they are shown in the table.
- WHMIS categorizes toxic materials in two divisions:
  - Division 1: Materials causing immediate and serious toxic effects (top symbol)
  - Division 2: Materials causing other toxic effects (bottom symbol)

GHS	WHMIS
	
	

## Chemical Hazards – Toxic Materials

Chemical Name	Potential Health Effects/Symptoms Associated with Toxicity (Note: not a complete listing of symptoms)
Methylene chloride	<ul style="list-style-type: none"> <li>Mild central nervous system depressant. May cause headache, nausea, dizziness, drowsiness, incoordination and confusion, unconsciousness and death.</li> <li>Causes skin and eye irritation.</li> </ul>
Isopropyl alcohol (2-propanol)	<ul style="list-style-type: none"> <li>Mild central nervous system depressant. High vapour concentrations may cause headache, nausea, dizziness, drowsiness, incoordination, and confusion. Very high exposures may result in unconsciousness and death.</li> <li>May be irritating to the respiratory tract.</li> <li>Causes eye irritation.</li> <li>Swallowing or vomiting of the liquid may cause aspiration (breathing) into the lungs.</li> </ul>
Acetone	<ul style="list-style-type: none"> <li>Mild central nervous system depressant.</li> <li>Very high concentrations may cause headache, nausea, dizziness, drowsiness, incoordination and confusion.</li> <li>Causes eye irritation.</li> <li>Swallowing or vomiting of the liquid may result in aspiration into the lungs.</li> </ul>
l-Limonene	<ul style="list-style-type: none"> <li>Causes moderate skin irritation.</li> <li>May cause allergic skin reaction.</li> </ul>
Acetaldehyde	<ul style="list-style-type: none"> <li>The vapour is irritating to the respiratory tract. May cause lung injury. These effects may be delayed.</li> <li>Causes severe eye irritation.</li> </ul>
Hydrogen peroxide (>35%)	<ul style="list-style-type: none"> <li>May be fatal if swallowed.</li> </ul>

## Chemical Hazards – Toxic Materials

Chemical Name	Potential Health Effects/Symptoms Associated with Toxicity of Very Toxic Material
Formaldehyde solutions	<ul style="list-style-type: none"> <li>• May be fatal if inhaled, absorbed through the skin or swallowed.</li> <li>• Gas is severely irritating to the eyes and upper respiratory tract. May damage the lining of the nasal cavity and the upper respiratory tract.</li> <li>• Causes lung injury-effects may be delayed.</li> <li>• Can cause cancer.</li> <li>• May cause genetic damage, based on animal information.</li> </ul>
Toluene-2,6-diisocyanate	<ul style="list-style-type: none"> <li>• Irritating to eyes, skin and respiratory tract. May cause lung injury. These effects may be delayed.</li> <li>• May cause severe allergic respiratory reaction.</li> <li>• May cause cancer.</li> </ul>
Acrylonitrile	<ul style="list-style-type: none"> <li>• May be fatal if inhaled, absorbed through the skin or swallowed.</li> <li>• Vapour is irritating to eyes and respiratory tract.</li> <li>• High vapour concentrations may cause headache, nausea, dizziness, drowsiness, incoordination and confusion. More severe exposures can cause bluish discolouration of the skin, collapse and death.</li> <li>• Causes severe skin and eye irritation.</li> <li>• Potential cancer hazard - causes cancer based on animal information.</li> </ul>
Hydrogen sulfide	<ul style="list-style-type: none"> <li>• May be fatal if inhaled.</li> <li>• Gas may be severely irritating to the eyes and respiratory tract.</li> <li>• Causes lung injury-effects may be delayed. Inhalation of high concentrations may cause respiratory paralysis, irregular heartbeat, collapse and death.</li> </ul>
Ethylene oxide	<ul style="list-style-type: none"> <li>• May be fatal if inhaled.</li> <li>• Irritating to the respiratory tract.</li> <li>• Central nervous system depressant. High concentrations may cause headache, nausea, dizziness, drowsiness, and incoordination.</li> <li>• Can cause cancer, based on human information.</li> <li>• May harm reproductive capability, based on animal information.</li> <li>• May cause inheritable genetic damage.</li> </ul>

## Hazard Control – Chemical

- **General tips for chemical safety**
  - Always read the label on the chemical bottle.
  - Always follow the directions and precautions listed on the label.
  - Never use a chemical if you are unsure what it is or how to protect yourself.
  - Always take the time to protect yourself and those working around you.
  - Always dispose of a chemical properly. Every municipality has a household hazardous waste drop-off location. For safe disposal of chemical products at work, contact your health and safety representative.

## Hazard Control – Chemical

- **Controlling chemical hazards in the workplace**
  - Reduce or eliminate the use of hazardous chemicals whenever possible.
  - Maintain adequate ventilation systems to reduce concentrations of airborne chemicals.
  - Practicing good personal hygiene (e.g. washing hands) and maintaining regular workplace cleaning routines can reduce the amount of a chemical substance that is absorbed by a worker's body. Learn how to avoid carrying hazardous substances home.

## Psychosocial Hazards

- **Psychosocial hazards are hazards that impact the mental state of workers.**
- **Violence, stress, and harassment are examples of this type of workplace hazard.**
- **Regulations have been enacted in recent years to protect workers from these hazards in the workplace. For example, most Canadian jurisdictions now have a requirement for employers to have workplace violence policy in place.**

## Hazard Control - Psychosocial

- **Preventive solutions**
  - Implementing collective risk assessment and management measures, as it is done with other workplace hazards
  - Adopting collective and individual preventive and control measures
  - Increasing the coping ability of workers by increasing their control over their tasks
  - Improving organizational communication
  - Allowing workers' participation in decision making
  - Building up social support systems for workers within the workplace
  - Taking into account the interaction between working and living conditions
  - Enhancing the value placed on safety and health within the organization

## Reckless Endangerment

**- Definition: Reckless endangerment consists of acts that create a substantial risk of serious physical injury to another person. The accused person isn't required to intend the resulting or potential harm, but must have acted in a way that showed a disregard for the foreseeable consequences of the actions.**

**- Workplace Violence -**

**“Worker must not engage in any prank, contest, feat of strength, unnecessary running or rough and boisterous conduct.”**



## Biological Hazards

- **Biological hazards are also known as biohazards. Any biological source of danger such as viruses, insects, etc. that can cause harm to the health of living organism is considered as a biohazard.**
- **Workplace diseases are also biohazards and using administrative hazard control methods such as workplace and employee hygiene, this hazard can be avoided.**
- **Employees who experience any symptoms of body abnormality should immediately report and be treated.**
- **Bio hazards are everywhere in the working environment and there is no certain area. Therefore, workers need to be aware and always take personal and workplace hygiene seriously.**



## Biological Hazards - Examples

Disease	Symptoms	Preventions
<p><b>Clostridium difficile:</b> This is a bacterium associated with diarrhea and intestinal inflammation. Normally affected by people who have other conditions.</p>	<p>Fever Nausea Abdominal pain Loss of appetite Watery diarrhea</p>	<p>Educate workers Hygiene practices in accordance to safety culture Appropriate protective clothing</p>
<p><b>Common cold:</b> This is an infection of upper respiratory tract, the nose, nasal passages and the throat.</p>	<p>Laryngitis (inflammation of the larynx) Worsening of asthma Ear infection Bronchitis (inflammation of the bronchial membranes)</p>	<p>Wash hands frequently Take fresh air every once in a while Stay out of contact of other people Use common cold consumer tablets</p>
<p><b>Indoor air quality – Moulds and Fungi:</b> This micro-organism generated from breakdown of leaves, wood and other plants can enter a building through air and they can grow on wood and/or drywall.</p>	<p>Eye, nose and throat irritation Fatigue Aggravation of asthma Headaches Concentration difficulty Cough</p>	<p>Vent showers and moisture generating Humidity control and dehumidifiers Exhaust fans when cooking or washing Immediate flood or spill cleaning Rapid stain removal of carpets</p>

## Biological Hazards - Examples

Disease	Symptoms	Preventions
<p><b>Hepatitis A:</b> This is a liver infectious disease caused by the hepatitis A virus (HAV).</p>	<p>Fever Tiredness Loss of appetite Nausea Adnominal pain Dark urine</p>	<p>Educate workers Hygiene practices in accordance to safety culture Appropriate protective clothing</p>
<p><b>Hepatitis B:</b> This is a liver infectious disease caused by the hepatitis B virus (HBV).</p>	<p>Mild symptoms such as general discomfort Joint pain Abdominal pain fatigue</p>	<p>Hepatitis A preventions plus: Safe collection of fluids and tissues for disposal Safe removal and disposal of protective clothing Detailed observation of using sharp objects</p>

## Biological Hazards - Examples

Disease	Symptoms	Preventions
<b>Hepatitis C:</b> This is a liver infectious disease caused by the hepatitis B virus (HBV).	Fever Nausea and vomiting Stomach pain Extreme fatigue Skin yellowing	Safe collection of fluids and tissues for disposal Safe removal and disposal of protective clothing Detailed observation of using sharp objects
<b>Influenza:</b> Caused by viruses that infect the respiratory tract including nose, throat and lungs.	Fever Cough Sore throat Runny nose Headache fatigue	Flu vaccines Canadian national advisory committee recommends flu shots for people over six months old.
<b>Hepatitis A:</b> This is a liver infectious disease caused by the hepatitis A virus (HAV).	Fever Tiredness Loss of appetite Nausea Abdominal pain Dark urine	Educate workers Hygiene practices in accordance to safety culture Appropriate protective clothing

## Physical Hazards

- Physical hazards are type of hazards that do not necessarily need any contact with the source and it can easily harm the body whether long term effects or instant damage.
- Some common physical hazards at workplace include but not limited to:
  - Noise
  - Electrical
  - Manual Labor



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## Hazard Control – Noise

- **Dependant on the context and conditions, but may include for example:**
  - **Eliminate the source of the noise where possible**
  - **Find alternative, quieter equipment to use**
  - **Insulate worker areas from noise producing machines**
  - **Reduce the amount of time spent in a high noise environment**
  - **Provide hearing protection**
  - **Provide hearing tests for workers to establish any loss of hearing attributable to work**

## Hazard Control – Electrical

- **Dependant on the context and conditions, but may include for example:**
  - **Ensure only appropriately licensed or registered electricians carry out electrical work**
  - **Switch off electricity where possible before working on equipment**
  - **Ensure electrical equipment is in good working order (testing and tagging)**
  - **Use battery operated tools rather than mains power tools where possible**
  - **Meet electrical safety standards**

## Hazard Control – Manual Labor

- **Dependant on the context and conditions, but may include for example:**
  - **Assess your workplace / workstation and identify risks or possible contributing factors**
  - **Is the task necessary?**
  - **Provide specialist equipment to assist in lifting/ carrying / moving people or objects**
  - **Carry smaller loads**
  - **Take breaks from repetitive work or introduce variation to the work**
  - **Plan work to avoid the need to lift/carry / move objects when your body is fatigued**
  - **Lower levels of stress. Tension in muscles long term can lead to injury**

## Physical Hazards - General Safety Hazards

There are many possible safety hazards that are categorized as general safety hazards, such as working at heights, machine pinch points and electrical shock.

**AVOID A FALL**



**USE  
HANDRAILS**

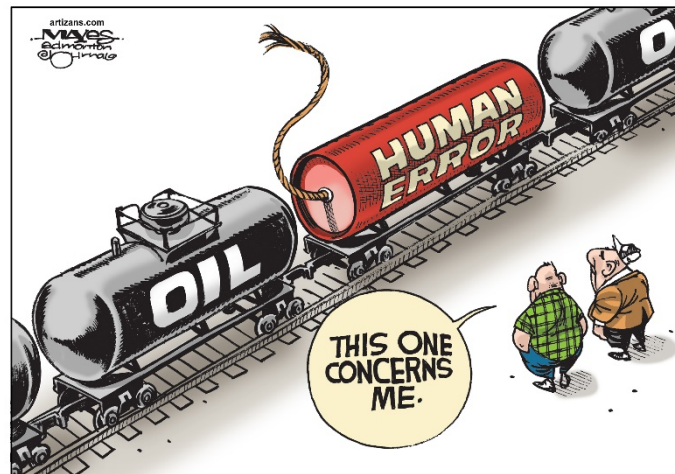
**DANGER**

**WATCH YOUR  
HANDS AND  
FINGERS**



## Physical Hazards - General Safety Hazards

- Safety hazards are known as general classification of hazards.
- These hazards consist of mechanical and human error hazards.
- For instance, slipping and tripping are considered safety hazards. Loss of concentration during walking and accidentally touching running equipment is also an example of a human error safety hazard.



## Physical Hazards - General Safety Hazards

- Improper machinery guarding is an example of a mechanical hazard.
- Equipment should be designed so that no part of a worker's body (e.g. hands, fingers, hair) can become entangled in or touch moving equipment.



## Hazard Control – Safety

### Preventive solutions

- According to the Canada Labour Code, the preventive measures for safety hazards are required by law.

### Section 19.5:

- The employer shall, in order to address identified and assessed hazards, including ergonomics-related hazards, take preventive measures to address the assessed hazard in the following order of priority:
  - the elimination of the hazard, including by way of engineering controls which may involve mechanical aids, equipment design or redesign that take into account the physical attributes of the employee

## Hazard Control – Safety

- **As part of the preventive measures, the employer shall develop and implement a preventive maintenance program in order to avoid failures that could result in a hazard to employees.**
- **The employer shall ensure that any preventive measure shall not in itself create a hazard and shall take into account the effects on the work place.**
- **The preventive measures shall include steps to address:**
  - **a newly identified hazard in an expeditious manner**
  - **ergonomics-related hazards that are identified when planning implementation of change to the work environment or to work duties, equipment, practices or processes**
- **The employer shall ensure that any person assigned to implement ergonomics-related prevention measures has the necessary instruction and training.**

## Hazard Control – Safety

- Certain hazards potentially pose such an elevated risk to workers, that they are singled out. Many companies call procedures related to these hazards “life saving rules” or “cardinal rules” as failure to follow these rules may result in death or severe injury.
- These hazards are also generally covered in regulations.
- Life saving rules:
  1. Lock, Tag, Clear, Try, Release
  2. Vessel Entry (Confined Space Entry)
  3. Line Breaks
  4. Fall Protection
  5. High Energy
  6. Intentional overriding of safety or environmental interlocks
  7. Reckless endangerment
  8. Seat Belts and mobile phones

## **Difference In Life Saving Rules From General Safety Rules**

- 1.Failure to follow Life saving rules have a higher potential to result in serious injury including death.**
- 2.Life saving rules are often regulated. (i.e. Lock, Tag, Clear, Try, Release (LTCTR), vessel entry, fall arrest, seat belts/ cell phones )**
- 3.The response is generally more severe to violations of life saving rules, often resulting in termination or disciplinary action.**

## High Risk Activities

# Introduction to high risk activities

## High Risk Activities

- **Activities at work that are dangerous and need special training and/or permit to perform, are referred as High Risk Activity (HRA).**
- **Depending on the job site, the activities may vary but some general HRAs are:**
  - **Driving**
  - **Fall from heights**
  - **High-Pressure cleaning**
  - **Working with high temperature equipment**
  - **Confined space**
  - **Line breaks**
  - **Suspended loads**
  - **Powered industrial trucks**

## Line Break

**Line Break: Opening cleared or uncleared lines or equipment by actions that may include, but are not limited to:**

- Breaking flanges
- Removing one or more bolts from flanges
- Removing valve bonnets and non-return (i.e., check) valve caps
- Breaking pipe joints
- Disconnecting tubing
- Disconnecting loading and unloading process hoses
- Opening inspection ports
- Making subtle adjustments (e.g., replacing packing on a valve)
- Before conducting a line break on site, formal training must be taken.

## Line Break

**Consider performing line break on a pipe:**

- **Ensure piping has been shut down, isolated, blocked and cleared per company's safe operation standards.**
- **Control all job related energy and/or flow sources and lock out for the time the line break is being performed.**
- **Ensure appropriate personal protective equipment have been used.**
- **Log all actions performed with exact date and time.**



## Fall Protection

- In Canada over 42,000 workers get injured annually due to fall accidents. This number represents about 17% of the “lost time injuries” that were accepted by workers' compensation boards or commissions across Canada (based on statistics from Association of Workers' Compensation Boards of Canada, 2011).
- All workers who use fall protection must be trained.
- Where possible, processes should be designed to eliminate or minimize working from heights



## Fall Protection

- **What is the difference between fall restraint and fall protection?**
  - **Fall restraint is a system that does not allow the worker to get to the edge.**
  - **Fall protection is required when working at the edge where no guard rail exists.**



## Fall Protection

- **DOSH requires employees working in heights to have special training.**
- **In addition to training, there are some regulatory safety equipment needed under OSH Regulations.**
- **For construction for instance, these equipment are:**
  - **Fall restricting system**
  - **Travel restraint system**
  - **Fall arrest system**
  - **Safety net**
  - **Work/Safety belt**



## Intentional Overriding of an Interlock

- Interlocks serve as important safety devices in industrial settings, where they protect employees from devices such as extruders, blenders, cutters etc.
- While interlocks can be something as sophisticated as curtains of infrared beams and photo-detectors, they are often just switches.



## Intentional Overriding of an Interlock

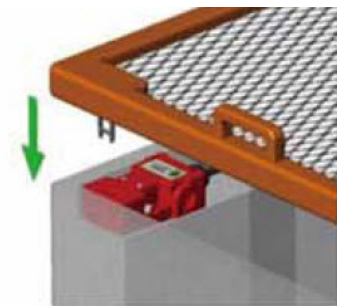
- **Safety instrumented function (SIF)**—also referred to as a PSM safety interlock. A function with a specified Safety Interlock, performed by an Safety Interlock System, that detects an out-of-limit (i.e., abnormal) condition or improper sequence and, without human intervention, either halts further action to prevent the process from entering an unsafe state or takes corrective action to bring the process to a functionally safe state. The SIF protects against the undesired consequence of a specific process hazardous event.



Hinged guard



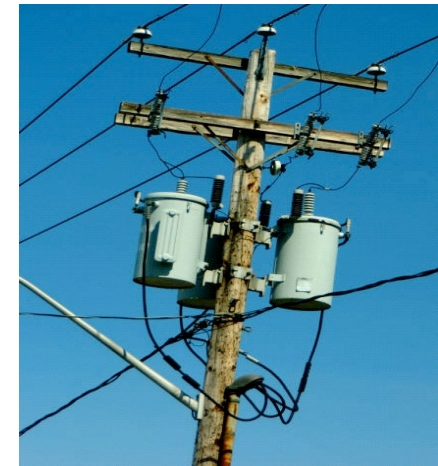
Sliding guard



Lift off guard

## High Energy or Live Work

- High energy is defined as a high energy circuit or device which when faulted can generate enough energy to create a fireball that will cause cell death by causing skin temperature to rise to at least 205°F in 0.1 seconds (*6 cycles*)- 2nd degree burns. A high energy device is any device with a supply of 600 V, 200amp, and fed from a 750 KVA transformer or higher.
- Only qualified electrical personnel may attempt any high energy switching
- High energy work is any work with voltage above 50V



### **WARNING**

#### Arc Flash and Shock Hazard

#### Appropriate PPE Required

<b>42 inch</b>	Flash Hazard Boundary
<b>4.75</b>	cal/cm <sup>2</sup> Flash Hazard at 18 inches
<b>Category 1</b>	6 oz/yd <sup>2</sup> (200 g/m <sup>2</sup> ) FR shirt and pants (or coveralls) of Nomex IIIA
<b>600 VAC</b>	Shock Hazard when cover is removed
<b>0</b>	Glove Class
<b>42 inch</b>	Limited Approach (Fixed Circuit)
<b>12 inch</b>	Restricted Approach
<b>1 inch</b>	Prohibited Approach

Bus: 61F-2 PP (Mezzanine - QMB 800A Mains) Prot: 8

## Drivers – Use of Cellphone

- **Notifications on hand-held devices while driving took effect by government.**
- **The law makes it illegal for drivers to talk, text, type, dial or email using hand-held cell phones and other hand-held communications and entertainment devices. The law also prohibits drivers from viewing display screens unrelated to the driving task, such as laptops or DVD players, while driving.**



## Drivers – Seat Belt

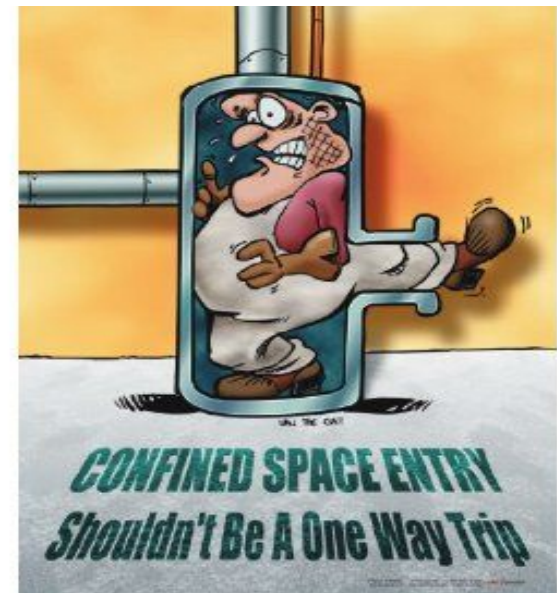
- **Today 93% of Canadians (Malaysian?) use their seat belts. Each percentage increase in the national seat belt wearing rate has helped to reduce the number of motor vehicle fatalities.**
- **The 7% of Canadians (Malaysian?) not wearing seat belts account for almost 40% of fatalities in vehicle collisions. Ensure that you wear your seat belt properly, and that everyone else in your vehicle is protected by a seat belt or child restraint.**
- **Seat belts save about 1,000 lives a year in Canada.**



## Confined Space

### Definition of confined space:

- 1) It is large enough to allow full-body entry.
- 2) It has a restricted means of entry and exit.
- 3) It is not designed for continuous human occupancy.



## Confined Space

- Many workers are injured and killed each year while working in confined spaces. An estimated 60% of the fatalities have been among the would-be rescuers.
- All workers who enter a confined space or who perform related work, must be trained.



## Confined Space

- According to DOSH, the confined space is regulated due to atmospheric hazards that may occur.
- The atmospheric hazards are:
  - *The accumulation of flammable, combustible or explosive agents,*
  - *An oxygen content in the atmosphere that is less than 19.5 per cent or more than 23 per cent by volume, or*
  - *The accumulation of atmospheric contaminants, including gases, vapours, fumes, dusts or mists, that could,*
  - *Result in acute health effects that pose an immediate threat to life, or*
  - *Interfere with a person's ability to escape unaided from a confined space.*

## Hazard Identification and Control

- Hazards at workplaces must be managed and controlled using appropriate methods.
- In Malaysia, hazard control is under provincial Occupational Health and Safety regulations or the OSH Act 1994, which clearly state that all the necessary precautions have to be taken to protect workers at workplaces.
- The law also states that all the necessary information must be clearly stated and available for workers that are operating different tools and equipment.
- Any potential source of danger at workplaces should be identified and treated as a hazard. Therefore necessary precautions must be applied.

## Hazard Identification and Control

### How to identify and control hazards:

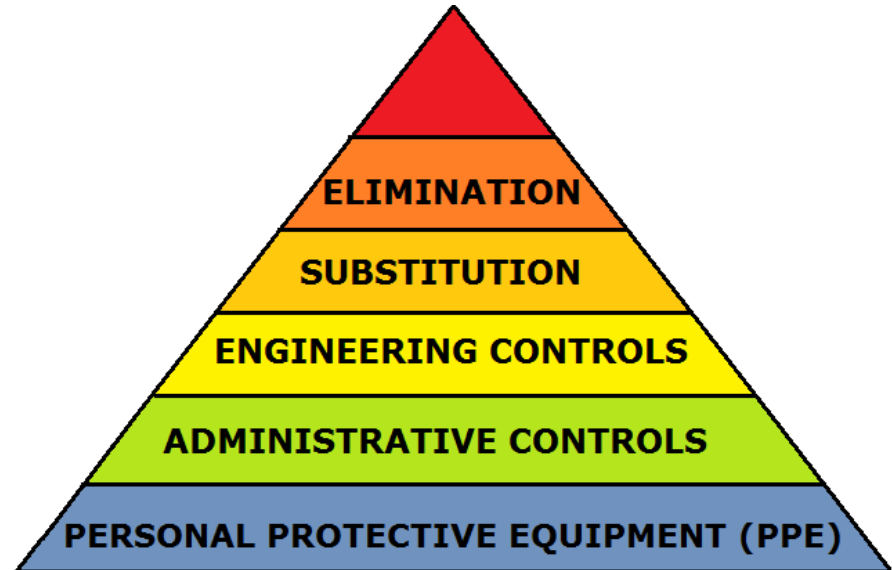
This diagram shows how a potential hazard can be controlled before causing any harm.



## Hazard Identification and Control

The methods for controlling hazards are as follow:

- Elimination or substitution
- Engineering controls
- Administrative controls
- Personal Protective Equipment (PPE)



## Hierarchy of Safety Controls or “Safeguards”

**Most Effective**

Elimination or substitution

**Most Expensive**

Engineering Controls

Warnings

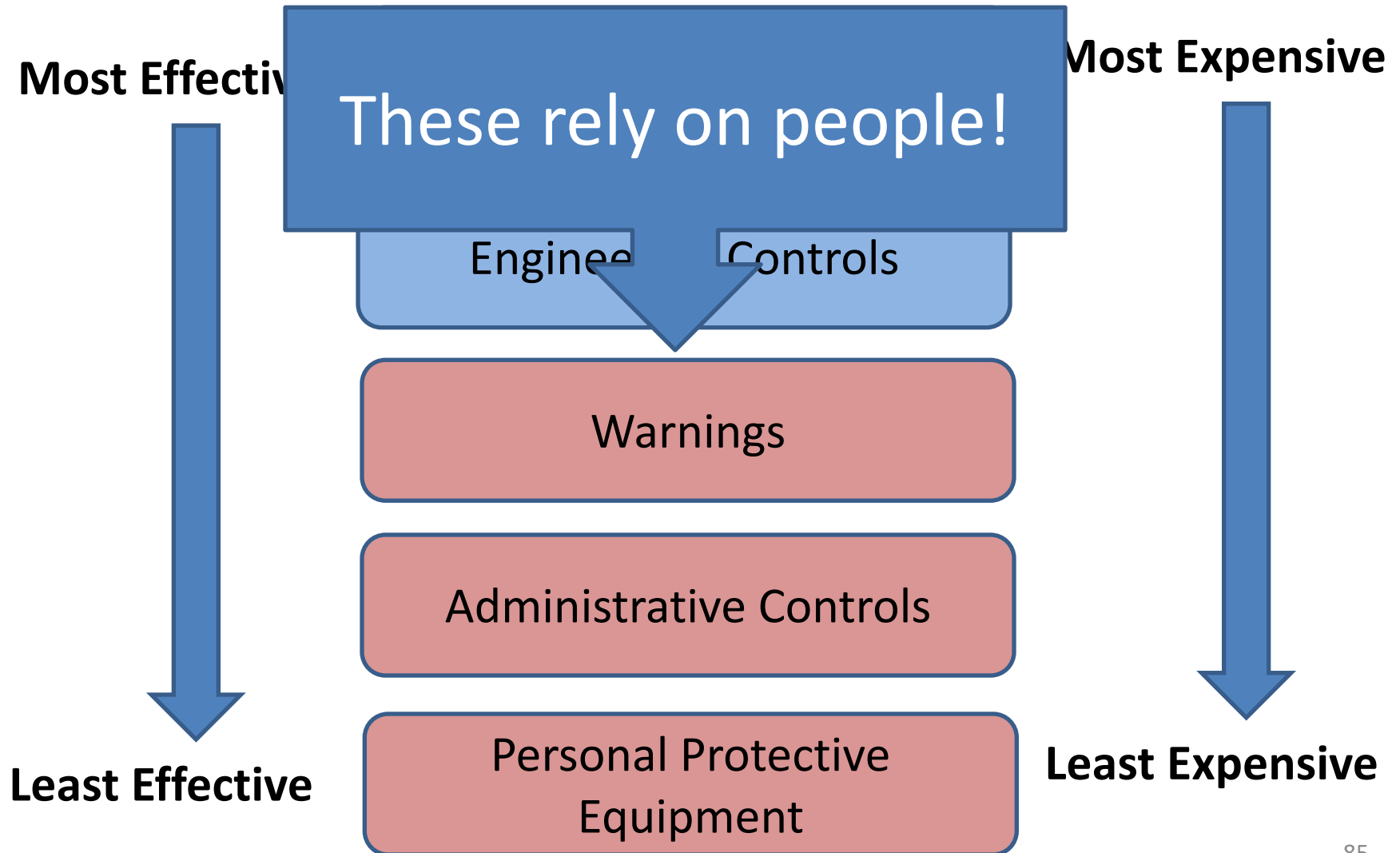
Administrative Controls

**Least Effective**

Personal Protective  
Equipment

**Least Expensive**

## Hierarchy of Safety Controls or “Safeguards”



## Hazard Identification and Control

**Let's look at examples of some of these controls**

## Elimination or Substitution

- **Elimination is the most effective risk control method as the hazard will permanently be removed from the job site.**
- **However, some hazardous materials are key components to the operation of that facility and cannot be eliminated**



## Elimination or Substitution

- Therefore, an alternate solution may be substitution of a less hazardous material. OSH Department uses the following example as suggestions for substitution of some chemicals.

Instead Of:	Consider:
carbon tetrachloride (causes liver damage, cancer)	1,1,1-trichloroethane, dichloromethane
benzene (causes cancer)	toluene, cyclohexane, ketones
pesticides (causes various effects on body)	"natural" pesticides such as pyrethrins
organic solvents (causes various effects on body)	water-detergent solutions
leaded glazes, paints, pigments (causes various effects on body)	versions that do not contain lead
sandstone grinding wheels (causes severe respiratory illness due to silica)	synthetic grinding wheels such as aluminium oxide

## Engineering Controls

- **Engineering controls are one of the most reliable methods of controlling hazardous materials and/or operations.**
- **It is simply an engineering design that has all the safety features to protect the workers and the working environment from hazards.**
- **There three types of engineering control method:**
  - **Ventilation**
  - **Process control**
  - **Enclosure and/or isolation of the emission source**
- **Engineering designs are playing an important role in controlling chemical hazards as there are designated engineered stations for testing, controlling the process and storing some highly hazardous chemicals.**

## Engineering Controls

- **As an engineer, some of your main working ethics should be:**
  - **Making products safe for all those in using environment**
  - **Value human life more than money**
  - **Have courage to admit your mistakes**
  - **Point out all the problems you find in your design**
- **It is important to ensure that all the actions you take as an engineer are well within the occupational health and safety act.**
- **Not only that, you should consider yourself as one of the responsible health and safety represents towards your design.**

## Engineering Controls

**The following list is some of the responsibilities that a safety engineer has:**

- **Research and interpret safety standards.**
- **Handle effective Industrial Hygiene Program.**
- **Support individual facilities to execute strategic initiatives to reach and sustain world class safety processes.**
- **Assess risk on safety and ergonomics.**
- **Evaluate facility procedures to determine conditions needing enhancement.**
- **Create, enhance and maintain company safety programs, training and reports.**
- **Lead safety project and manage risk execution using project management skills.**

## Engineering Controls– Safety engineer responsibilities

- **Oversee facility and processes to adhere to OSHA and corporate guidelines.**
- **Suggest measures to minimize or eliminate industrial accidents and health hazards.**
- **Develop, execute and handle occupational safety and health procedures.**
- **Develop and review safety procedures.**
- **Extend field support and support during normal operations and maintenance shut down.**
- **Audit, investigate accident and analyze root causes and take corrective action.**
- **Guide for kaizen and small group safety projects and assist Environmental Health and Safety (ISO) activities.**

## Engineering Controls – Ventilation

- **Ventilation can eliminate or reduce released gases, debris, etc. by clearing the contaminated air and replacing it with clean air in the working environment.**
- **Ventilation is extremely adaptable and applicable to most chemicals and operations and has the ability to quickly remove the contaminated air from work environments.**
- **Engineered ventilation systems can be readily accessible at the designated work stations and the workers can control the system while working.**

## Engineering Controls – Ventilation

**This image shows a practical example of a flexible ventilation system. This picture was taken at DuPont Canada, Kingston, ON facility.**



## Engineering Controls – Ventilation

- The hood, located at the face of the vent, helps capture and remove contaminants from the area.
- The ductwork moves the air to a rooftop vent or cleaning device, such as a thermal oxidizer or absorber, that may be engineered into the system.
- In some cases, there is an exhaust fan on top instead of a cleaning device.
- The exhaust fan must overcome all the losses due to friction, hood entry and fittings in the system to produce the intended flow.
- Air cleaning devices are important as they clean the air from any particles, gasses, vapours, etc. and protect the surrounding environment by sending clean air to the exhausts.
- These ventilation devices generally require provincial air discharge permits.

## Engineering Controls – Process Control

- **Process control is monitoring a process carefully using engineering devices to ensure all the safety considerations are taken into account and the process will not be hazardous to the workers.**
- **Process management of change for the facilities as well as the technology are important tools to reduce hazards.**
- **For instance, using water for grinding and drilling can improve the safety, as the friction force between the equipment and work surface reduces, therefore the equipment will not heat up and sparks are less likely to be generated.**
- **Using electric motors rather than diesel ones is environmentally friendly and eliminates diesel emissions.**
- **Using mechanical equipment rather than manual methods for transportation can eliminate ergonomic and other safety hazards.**

## Engineering Controls – Enclosure or Isolation

- Enclosing hazards will help protect workers from the hazards.
- For example, reactive chemicals that were recently used in the workplace could still be reactive and pose a hazard if not properly enclosed and controlled. Isolating the work area is an effective means of controlling the hazard.
- The use of ventilation tools such as fume hoods, elephant trunks, and ventilated enclosures which are close to work stations and/or throughout the job site provides a means of reducing risk of exposure to chemicals

## Engineering Controls Examples



An example of engineering design for process control and ventilation



An example of engineering design for potential leaking chemicals



An example of engineering design for lock out

## Hazard Control

**Let's move on to "Administrative Controls"**

## Administrative Controls

- **Examples of administrative controls are:**
  - **Education and training**
  - **Work practices and safety culture concept**
  - **Personal and facility hygiene**
  - **Emergency response and preparedness**

## Administrative Controls

- Can help protect workers by:
  - setting boundaries to work stations
  - providing specific rules and guidelines
  - setting time limits for working around hazardous areas
  - ensuring the personal protective devices are at the workers disposal are examples of administrative controls.
- Another effective administrative control is posting signs visible to workers at the entrance of each room to identify hazards and the required Personal Protection Equipment (PPE). This way, workers will be informed about the possible dangers and how the danger can be prevented.



## Administrative Controls – Education and Training

- **There are various ways for an employer to provide education and training to raise awareness of occupational health and safety hazards and issues:**
  - **Hands-on training in an operating area**
  - **Classroom instruction**
  - **Regular safety meetings, daily, weekly or monthly**
  - **Email or posting printed material concerning are forms of educating workers under administrative control.**
- **It is important to verify the effectiveness of the training by testing or quizzing the workers about the health and safety at the workplace. This ensures the workers understand the training.**
- **Safety education may also contain information on emergency response, to ensure proper response/rescue and prevent additional injuries or fatalities.**
- **If a location cannot provide on site emergency response, arrangements with trained professionals can be made.**

## Administrative Controls – Work Practices and Safety Culture Concept

- **Generating rules and regulations in regards to safe operation of workplace equipment is the main objective of work practices or performance control.**
- **Proper maintenance and test schedules for equipment is also important to ensure safe operation.**
- **By creating a safe work practice environment, the safety culture will be more effective and the workers will follow the safety culture.**



Ref: Sign media, free sign, UK

## Administrative Controls – Personal and Facility Hygiene

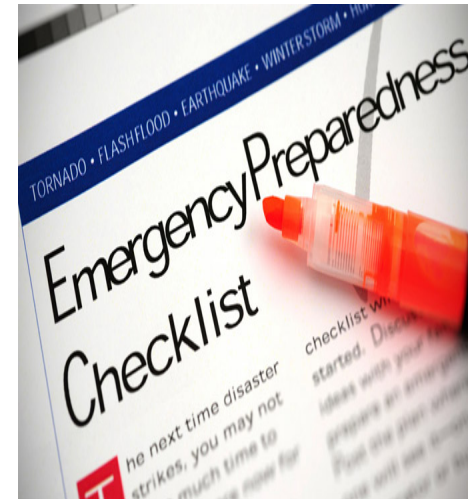
- **Poor industrial hygiene in the workplaces raises the potential for occupational injury and illness.**
- **Using administrative controls, such as housekeeping protocols and safe handling procedures, the employers can provide a clean working environment that helps remind the employees of the importance of a good safety culture, and operating discipline.**
- **Good operational discipline will positively impact production and quality as well.**
- **It is also important to use administrative signs and isolate contaminated areas to ensure safety of workers.**
- **PPE must also be kept clean and in good repair.**

## Administrative Controls – Emergency Response and Preparedness

- **Some facilities may have trained emergency crew on site to handle specific hazardous occurrences at work; however, all workers must be aware of the basic emergency responses to be prepared in emergency situations.**
- **Emergency responders may also be exposed to bodily fluids such as vomit or blood which contain pathogens.**
- **In an emergency, the situation can be controlled until emergency crews arrive at site. Also, workers will keep themselves safe from the hazards.**

## Administrative Controls – Emergency Response and Preparedness

- Ensuring that trained First aid and CPR resources are available with training updated at appropriate intervals helps ensure the quality of response.
- Having an emergency preparedness checklist, helps remind workers about potential concerns and how to respond in case of emergencies.



Ref: Sign media, free sign, UK

## Lock, Tag, Clear, Try, Release (Lockout/Tagout)

- Every year in Canada, workers are injured or killed because equipment, machinery or processes were not properly locked out.
- Lockout is used during operations such as maintenance, repair, cleaning and replacement of machinery, during which normal control measures may not be working, and new hazards may occur.



## Administrative Controls

Let's study the two very detailed administrative hazard control systems



## Administrative Controls – WHMIS

- WHMIS is a nationwide system developed to provide information on hazardous materials at workplaces. This system has been in effect in Canada since 1988.
- WHMIS also brings a classification system to list all the materials within the workplace in a data sheet.
- MSDS (Material Safety Data Sheets) is what required by WHMIS to be present in workplaces working with hazardous materials.
- Currently WHMIS requires 9 sections for MSDS.

**W** → **Workplace**

**H** → **Hazardous**

**M** → **Materials**

**I** → **Information**

**S** → **System**

## Administrative Controls – GHS (WHMIS 2.0)

- WHMIS regulations were modified to include the requirements of the Globally Harmonized System (GHS).
- GHS is a system of classification and labeling of the hazards.
- It communicates health and safety on labels and safety data sheets (SDS) with a goal of harmonizing the hazard classification and labeling system globally.
- GHS was developed by an international group of health and safety experts.

**G** ➡ **Globally**  
**H** ➡ **Harmonized**  
**S** ➡ **System**

## Administrative Controls – WHMIS (Controlled Products)

- **Controlled products are materials that are regulated by WHMIS to be listed as hazardous materials.**
- **Controlled substances fall into one or more categories of the 6 WHMIS categories.**
- **WHMIS intends to raise awareness for all the workers working with controlled products to be aware of the danger and wear the appropriate Personal Protection Equipment (PPE).**
- **WHMIS training is MANDATORY for all the workers working with chemicals.**



## Administrative Controls – WHMIS Symbols

**Class A**

Compressed  
Gas

**Class B**

Flammable  
and  
Combustible  
Material

**Class C**

Oxidizing  
Material

**Class D**

1. Materials  
Causing  
Immediate  
and Serious  
Toxic Effects

**Class D**

2. Materials  
Causing  
Other  
Serious Toxic  
Effects

**Class D**

3. Biohazardous  
Infectious  
Materials

**Class E**

Corrosive Material

**Class F**

Dangerously  
Reactive  
Material

## Administrative Controls – WHMIS Labeling

The diagram shows a WHMIS label for Methanol with the following components and annotations:

- Name of the product:** Points to "METHANOL" and "MÉTHANOL".
- Risks of the product:** Points to "DANGER", "POISON", "FLAMMABLE", "VAPEUR HARMFUL", and "MAY CAUSE BLINDNESS IF SWALLOWED".
- Precautionary measures:** Points to the English text: "Keep away from heat, sparks and flame. No smoking. Container must be grounded when being emptied. Vapour may travel long distance. Avoid contact with eyes and skin. Do not inhale vapours or mist. Do not take internally. Harmful if absorbed through the skin." and the French text: "Garder loin de la chaleur, des étincelles et des flammes. Ne pas fumer. Brancher le contenant à une prise de terre avant de le vider de son contenu. Les vapeurs peuvent s'étendre sur de longues distances. Éviter tout contact avec les yeux et la peau. Ne pas respirer les vapeurs. Ne pas absorber. Nocif si absorbé par la peau."
- First aid information:** Points to the English text: "FIRST AID: In case of contact, immediately flush eyes and skin with plenty of water for at least 15 minutes. If swallowed, induce vomiting by sticking finger down throat, or by giving soapy water to drink. Repeat until vomit is clear. If affected by vapour, move to fresh air. If breathing has stopped, apply artificial respiration." and the French text: "PREMIERS SOINS: En cas de contact avec les yeux ou la peau, laver à grande eau pendant au moins 15 minutes. Si avalé, provoquer le vomissement en introduisant un doigt dans la gorge ou en faisant absorber de l'eau savonneuse à la victime. Répétez jusqu'à cessation du vomissement. Sortir au grand air, si indisposé par les vapeurs. Si la respiration est interrompue, recourir à la respiration artificielle."
- Precautionary measures:** Points to the English text: "GET MEDICAL ATTENTION IMMEDIATELY. PRECAUTIONS: Wear chemical goggles and resistant gloves. Wash thoroughly after handling. Use with enough ventilation to keep below TLV. Keep container closed. Never use pressure to empty container." and the French text: "OBTENIR DES SOINS MÉDICAUX IMMÉDIATS. PRÉCAUTIONS: Porter des lunettes protectrices (pour produits chimiques) et des gants résistants. Se laver minutieusement après usage. Utiliser dans un endroit bien aéré, afin de maintenir un niveau de vapeurs tolérable. Garder le contenant fermé. Ne jamais user de pression en vidant le récipient."
- Hatched border:** Points to the black and white diagonal border of the label.
- Hazard Symbol:** Points to the flame symbol and the health hazard symbol (T).
- Supplier Information:** Points to the bottom section: "SEE MATERIAL SAFETY DATA SHEET FOR PRODUCT / VOIR FICHE SIGNALÉTIQUE", "ABC Company", and "Anytown, Ontario Telephone 123-4567".

Ref: Ontario ministry of labor

## Administrative Controls – GHS Labeling

**EPICHLOROHYDRIN** **1** **Product Identifier**

UN No. 2023  
CAS No. 106-89-8

**2** **Signal Word**  
**DANGER**

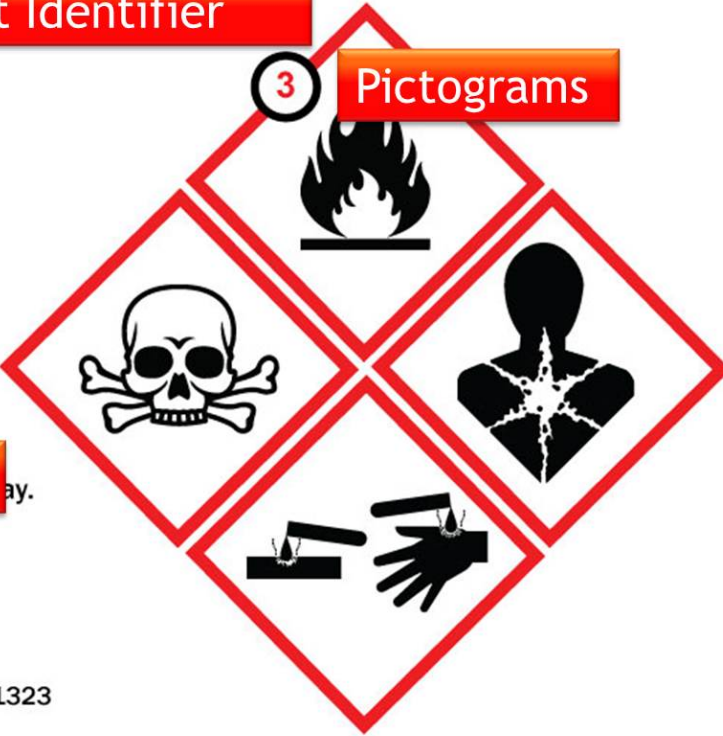
**3** **Pictograms**

**4** **Hazard Statements**  
Flammable. Swallowed.  
Toxic in contact with skin. Causes severe skin  
burns and eye damage. May cause an allergic  
skin reaction. May cause cancer.

**5** **Precautionary Statements**  
Do not breathe vapors. May.  
Wear protective gloves/protective clothing/eye  
protection.

**6** **Supplier Information**  
JACKSON CHEMICAL COMPANY - City of Industry, Los Angeles, California, USA (800)-444-456-8989

Fill Weight: 18.52 lbs. Lot Number: A0323111323  
Gross Weight: 20 lbs Fill Date: 1/15/2012  
Expiration Date: 1/15/2018



## Administrative Controls – WHMIS Symbols Vs. GHS Pictograms



Flammable

Acute  
ToxicityHealth  
HazardChronic  
Hazard

Corrosive

Reactive

Oxidizer

Compressed  
Gas

Aquatic Toxicity

(NOT adopted By Canada or U.S.)

## Personal Protective Equipment (PPE)

- PPE is considered the last line of defense from a hazard and an important part of hazard control.
- Some types of PPE are chemical protective clothing, hard hats, safety shoes, respiratory equipment, gloves, etc.
- Part of administration control is managing the information about PPE for every hazard within the facility.
- It is important for every worker to know the selection process for PPE.



*Ref: Sign media, free sign, UK*

## PPE Selection Process

1. Identify hazards within the work area
2. Identify the possible harms may be resulted from those hazards
3. Select the appropriate PPE
4. Ensure proper fit of the PPE

## Decision Making

# Decision making

1. Identify problem or opportunity
2. Collect information
3. Analyze the situation
4. Develop options
5. Evaluate the options and alternatives
6. Make a selection
7. Implement the decision

## Decision Making

- As this seems to be a natural instinct for people to make decisions on a daily basis; however, there is a science behind making an educated decision to minimize the risks.
- These 7 steps are recommended for making an educated decision
  1. Identify a problem or opportunity
    - Recognizing a problem and identifying whether the problem is worthwhile to be solved is the first step.
    - What should be focused is the reality behind the issue and one can consider whether the decision can satisfy questions such as:
      - Will it make a difference?
      - How worthwhile will it be?
  2. Collect as much as information as possible
    - What needs to be known before making a decision is very important.
    - Also, seeking help from people working in that area for their knowledge is beneficial.

## Decision Making

### **3. Analyze the situation**

- Define the available alternative actions.
- Analyze whether the situation can be controlled by those alternatives.

### **4. Develop options**

- Develop several possible options for the situation.
- For each option, one can ask “what if” questions to determine the options are sufficient enough.

### **5. Evaluate the options and alternatives**

- Evaluate feasibility, acceptability and desirability.
- Determine the best alternative that will achieving the objective

## Decision Making

### 6. Make a selection

- Select the proffered alternative
- Determine if there might be any problems it create.

### 7. Implement the decision

- After careful consideration and following the necessary steps, act on the decision.
- Reconsider the allocated resources for implementation and make sure this is accepted and supported by colleagues.



## Decision Making Matrix

- In this table the options and objectives are listed. Based on the each objective, an option will be rated to determine the overall level of importance.
- For instance, considering an equipment change in a factory, the employee responsible to make an educated decisions can consider the following objectives:
  - Cost
  - Safety
  - Durability
  - Adaptability/trainability
  - Overall effectiveness
- Please note that the objectives may vary based on the employer's decision or other factors.

## Decision Making Matrix

Let's say your employer asked you to choose the best option for an old equipment replacement; How would you rate the objectives?

	Cost	Safety	Durability	Effectiveness	Total
Option 1: Do not change					
Option 2: Brand new purchase					
Option 3: Used purchase					

## Decision Making Matrix

	Cost	Safety	Durability	Effectiveness	Total
Option 1: Do not change	10	2	1	1	14
Option 2: Brand new purchase	3	10	10	7	30
Option 3: Used purchase	5	7	6	4	22

- The rating in this example shows that buying a brand new equipment might be a better option.
- In order to get more accurate results, it is strongly recommended to weigh each objective. For instance, safety always comes first and must have the highest weight. Therefore, the rate of the option can be multiplied by the weight.

## Decision Making Matrix

Considering the example below with the following rates of cost (8), Safety (10), Durability (8) and Effectiveness (7):

	Cost	Safety	Durability	Effectiveness
Option 1: Do not change	10	2	1	1
Option 2: Brand new purchase	3	10	10	7
Option 3: Used purchase	5	7	6	4

Then the result for option 2 will be as follow:

$$(3 \times 8) + (10 \times 10) + (10 \times 8) + (7 \times 7) = 253$$

## Risk Assessment

- **One of the most critical processes to prevent tragedies is risk assessment where:**
  1. **The hazard will be identified.**
  2. **The risk associated with that hazard will be evaluated.**
  3. **The appropriate solutions will be determined to whether control or eliminate the hazard.**
- **Anything at workplace that may cause harm, particularly to people should be identified as a hazard and the risk assessment should be conducted to control or eliminate.**

## Risk Assessment

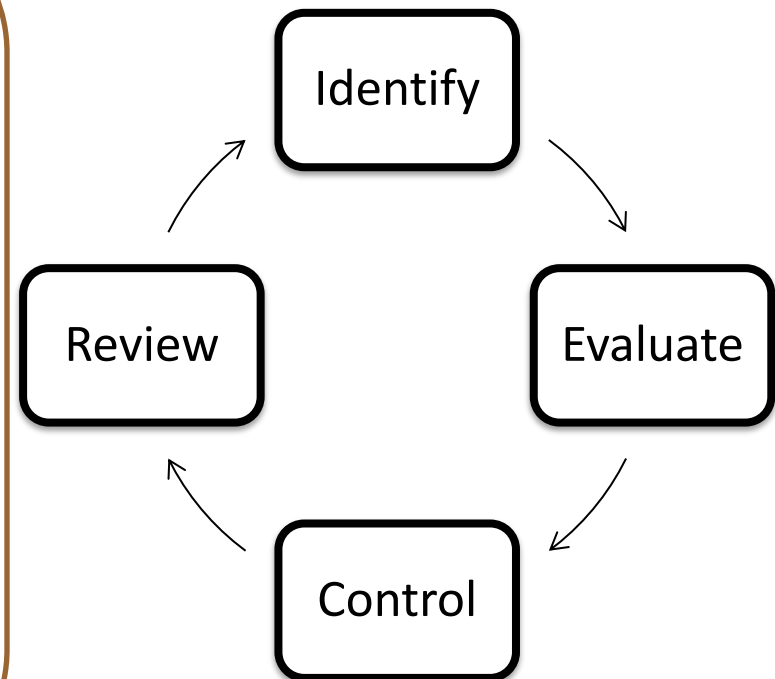
- **Risk assessment is beneficial as it helps to:**
  - Identify who might be at risk (employees, staff, visitors, contractors, etc.)
  - Prioritize hazards and control measures
  - Determine of adequacy of existing control measures
  - Prevent injuries or illnesses
  - Create awareness and inform people of the existing risks

## Risk Assessment

- Risk assessment aims to remove a hazard or reduce the level of the risk to an acceptable level.
- The assessment should consider all equipment as well as employees
- A risk assessment matrix is one of the very effective methods to determine the level of severity of the risk.
- Below are some of the components that should be taken into account for conducting risk assessment.
  - Identification of hazards
  - Consideration of different circumstances such as power outage, shutdowns, emergencies and normal operational situations
  - Evaluation and monitoring of the risk to ensure it is under control

## Risk Assessment

- Evaluation of likelihood and severity of the injury or illness
- Reviewing all the available health and safety information about the hazard such as MSDSs, manufacturers literature, results of testing, etc.
- Keeping any necessary documentation or records that include the detailed risk assessment technique outlining evaluation details and conclusions.



## Risk Assessment

- **Below is a summarized version of hazard identification process:**
  - **Conduct a research of past incidents including their severity and any harm or damage resulted**
  - **Consider all the people helping the workplace to operate (employees, drivers, cleaners, etc.)**
  - **Include non-routine activities such as maintenance or repair**
  - **Overlook the possible impacts of the hazards as well as the foreseeable unseal conditions**
  - **Include risk assessment for the visitors and the public**
  - **Ensure the risk assessment accounts for new and less experienced people**

## Risk Assessment

- Each hazard should be studied individually to determine the possible and the level of the risks it may cause. The following methods are recommended to study a hazard:
  - Product information issued by the manufacturer
  - Facts about that product and past experiences
  - Information from trustworthy sources and organizations
  - Reviewing MSDS/SDS and manufacturer documentation
  - Help from occupational health and safety professionals
  - Test results of the hazardous materials or equipment
  - Previous injury information

## Risk Assessment

- The following factors are important to contribute to the level of risk:
  - The work environment
  - The system being used
  - The range of foreseeable conditions
  - The capability, skill and experience of the workers



## Risk Assessment

- In order to determine the severity of the hazards, they should be ranked and prioritized. It is important to consider personnel exposure to the hazard first and treat this as a priority. Below are recommended for ranking and prioritizing:
  - Percentage of workforce exposed
  - Degree of harm
  - Probability of the occurrence
  - Frequency of exposure
- The above are helpful but not limited. There is no simple one way to understand the importance of the risks caused by hazards.
- Risk assessment matrix is a very effective method to determine the risks of hazards.
- The matrix is in form of a table that basically determines the likelihood and the severity of the hazards

## Risk Assessment Matrix

- The following terms are used to define the likelihood of harm:
  - Very Likely
    - This is the most frequent likeliness of the occurrence. For instance, if a worker is exposed to the hazard on every work shift, it is very likely to harm more people
  - Likely
    - This level could indicate a typical exposure of once a year
  - Unlikely
    - This indicates the very low percentage of the exposure; normally once in a lifetime.

## Risk Assessment Matrix

- **Very Unlikely**
  - This is the least risk level and it is normally an educated assessment of a chance of exposure of 1% by an individual in their working lifetime.



*Ref: Pamikan, Risk assessment*

## Risk Assessment Matrix

### Definition for severity of harm

When the potential severity of harm needs to be established, consider the following:

1. Part(s) of the body likely to be affected.
2. Nature of the harm:
  - Slightly harmful
    - ❖ First Aid Treatment - Minor cuts, scratches, eye irritation from dust, etc.
  - Harmful
    - ❖ Medical Treatment - Burns, concussion, minor fractures, etc.
  - Extremely harmful
    - ❖ Lost or Restricted Work - Major fractures, poisoning, fatal injuries, etc.

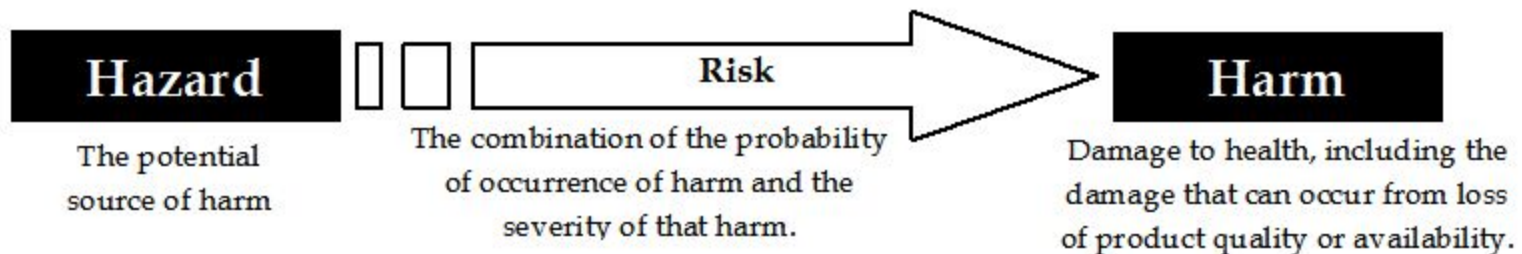
## Risk Assessment Matrix

### Definition of risk level

- **Very high**
  - These risks are unacceptable and are need of immediate attention and control measures. In most cases these risks are controlled for the workplace lifetime.
- **High**
  - Substantial efforts must be made to reduce the risk and eliminate any possible harm it may cause. These risks are also in need of proper control measures.
- **Medium**
  - Careful considerations must be taken into account whether the risks could be lowered or not and apply control measures if necessary.

## Risk Assessment Matrix

- **Low**
  - These risks are normally not in need of control measures unless they can be implemented at a very low cost.
- **Very low**
  - These are acceptable risks and there is no further action required for their control.



*Ref: Quality risk analysis, Intehopen*

## Risk Assessment Matrix

### Example of hazard priority setting

Table 4 Example of Hazard Priority Setting				
	Very likely - could happen at any time	Likely - could happen sometime	Unlikely - could happen but very rarely	Very unlikely - could happen but probably never will>
Kill or cause permanent disability or ill health	1	1	2	3
Long term illness or serious injury	1	2	3	4
Medical attention and several days off work	2	3	4	5
First aid needed	3	4	5	6

From: Hazpak: Making your workplace safer. A practical guide to basic risk management by WorkCover New South Wales, Australia.[n.d.].

*Ref: Hazard and risk assessment, CCOHS*

## Risk Assessment Matrix

An example of a risk matrix

**Risk Matrix**

Likelihood ↑	Very likely	Acceptable risk Medium 2	Unacceptable risk High 3	Unacceptable risk Extreme 5
	Likely	Acceptable risk Low 1	Acceptable risk Medium 2	Unacceptable risk High 3
	Unlikely	Acceptable risk Low 1	Acceptable risk Low 1	Acceptable risk Medium 2
What is the chance it will happen?		Minor	Moderate	Major
		Impact → How serious is the risk?		

## Case Study

The lack of clear instructions and proper supervision in the dangerous business of demolition lay at the core of a breach of the Occupational Health and Safety Act that resulted in a \$75,000 fine being imposed on Delta Pty Ltd in the Industrial Relations Commission.

This conclusion by Justice Boland in the case that led to two workers sustaining serious injuries after a building collapsed sent a clear safety message to all demolition operators, the Acting General Manager of WorkCover NSW stated.

In 1997 the defendant was contracted to demolish a number of buildings on the Fox Studio premises in Sydney. On 30 May one of the buildings was being demolished in a method known as controlled collapse.

Two employees of the defendant were on a scissor lift cutting timber purlins inside the building when the structure collapsed, toppling the lift. One worker sustained a compound fracture to one arm, injuries to the liver, fractured ribs and a fractured pelvis. The other employee suffered a fractured pelvis, loss of several teeth, and injuries to his tendon, cheek and mouth.

## Case Study

The court heard that hinge cuts and rust in several of the building's steel supports had weakened the structure and contributed to its collapse. Justice Boland said that the absence of the demolition supervisor as approved by the defendant's state manager, and his replacement with someone who was not experienced enough for such a dangerous operation, was a serious error of judgement in respect of the defendant's responsibilities under the Occupational Health and Safety Act.

## Case Study

1) How many employees were injured in the accident?

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2) Identify the hazard(s) in the article above.

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3) List the factors that contributed to the accident.

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4) List some control measures that could have been used to prevent the accident.

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5) Why was the employer held responsible.

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## Review

- **Accidents are unwanted and can happen anytime during a working shift.**
- **What matters is understanding how we can predict the possible accidents and prevent them from turning into tragedies.**
- **Those accidents that can cause harm to people and the workplace are categorized as hazards when it comes to occupational health and safety.**
- **A responsible employer has all the safety measures to identify and control hazards to provide a safe working environment for employees.**
- **Learning from past experiences is important. As engineers, it is your responsibility to perform tasks with extra caution and check the outcome over and over again to ensure worker safety.**
- **Your iron ring is a reminder of a tragedy in 1907 - the Quebec bridge collapse.**
- **With the advantages of today's tools and technologies, tragedies such as these can be avoided.**

## Review

- **Past reports of injuries and fatalities are always good references to understand how important hazard control and safety considerations are.**
- **The Quebec bridge collapsed two times and cost 88 lives and the iron ring is a continuing reminder of that tragedy.**
- **Always think safe, stay safe and decide safe.**



## Review – Types of hazards

- Ergonomics
- Chemical
- Psychosocial
- Biological
- Physical
- Safety
- High Risk Activities



*Ref: Sign media, free sign, UK*

## Review – Physical Hazards

- **A physical hazard is defined as "A factor within the environment that can harm the body without necessarily touching it. Vibration and noise are examples of physical hazards"**
- **Physical hazards include, but aren't limited to, electricity, radiation, pressure, noise, heights and vibration**

## Review – Physical Hazards – Noise mitigation

- **Considering a common physical hazard, noise, the risks are as follow:**
  - **Temporary loss of hearing or permanent hearing loss from exposure to noise exceeding prescribed standards.**
  - **Tinnitus (or ringing in the ears) which usually goes away but in severe cases it may not, causing additional problems**
- **The first recommendation to eliminate the hazard is to replace the equipment with one that is quieter.**
- **However, understanding that the above might not be feasible, the worker may reduce the time working around the noisy equipment and use appropriate hearing protection.**

## Review – Chemical Hazards

- **Chemical hazards require close evaluation, as the harm can be permanent and catastrophic.**
- **There are many materials at workplaces that can be categorized as chemical hazards. A common one is cleaning products. If a company has variety of chemical products for business use, then strict hazard control methods should be applied to ensure safety.**
- **Compressed gases, cleaning products, asbestos, carbon monoxide, organic peroxide, flammable and/or toxic liquids are some examples of chemical hazards within workplace.**
- **Using specific areas for storing chemicals and chemical resistant surfaces for liquid chemicals, is an essential practice.**
- **It is important for workers to know where the closest safety showers and eye wash stations are to flush the exposed area in case of an exposure.**

## Review – Ergonomics

- **An ergonomic hazard is a physical factor within the environment that harms the musculoskeletal system. Ergonomic hazards include things such as repetitive movement, manual handling, workplace/job/task design, uncomfortable workstation height and poor body positioning.**
- **Other examples are improper lifting, or lifting over the recommended weight limit.**
- **Workers need to recognize that what may seem to be comfortable for them may actually pose a longer term ergonomic risk.**

## Review – Industrial Hygiene

- **This common hazard is the diseases within the workplaces.**
- **It is very important to maintain personal hygiene at workplaces and always wash hands and stay clear of the people who seem to be sick.**
- **Some chemical materials may also cause biological hazards which means in case of exposure, the individual will become sick depending on the type of material that has been used in the chemical.**
- **Emergency responders may also be exposed to bodily fluids such as vomit or blood which contain pathogens.**
- **PPE and the workplace must be kept clean**

## Review – Psychosocial Hazards

- **Psychosocial hazards are types of hazards that have an impact on the mental state of workers.**
- **Violence, discrimination, and harassment are examples of this type of hazard which can lead to stress.**
- **Changes to regulations and social norms mean that some types of discrimination and harassment are less prevalent than in years past. For example, people were sometimes discriminated against for age, gender or sexual orientation.**
- **It is recommended that workers talk to a trusted resource, such as a friend, therapist, supervisor or manager to ensure that the issue is resolved.**
- **Many workplaces have Employee Assistance Plans to assist workers in dealing with psychosocial hazards.**

## Review – Safety Hazards

- This general hazard category focuses on two aspects - mechanical hazards and human error hazards.
- Examples for this hazard are slips, trips and falls, being struck by a tool or moving equipment, and situations that may cause MSDs.
- Below are additional examples:
  - Careless driving habits
  - electrical hazards
  - Spills on floors or tripping hazards such as blocked aisles or cords running across the floor
  - Working from heights including ladders, scaffolds, roofs, or any raised work area
  - Unguarded machinery and moving machinery parts; guards removed or moving parts that a worker can accidentally touch
  - Electrical hazards like frayed cords, missing ground pins, improper wiring
  - Confined spaces

## Review – High Risk Activities (HRA)

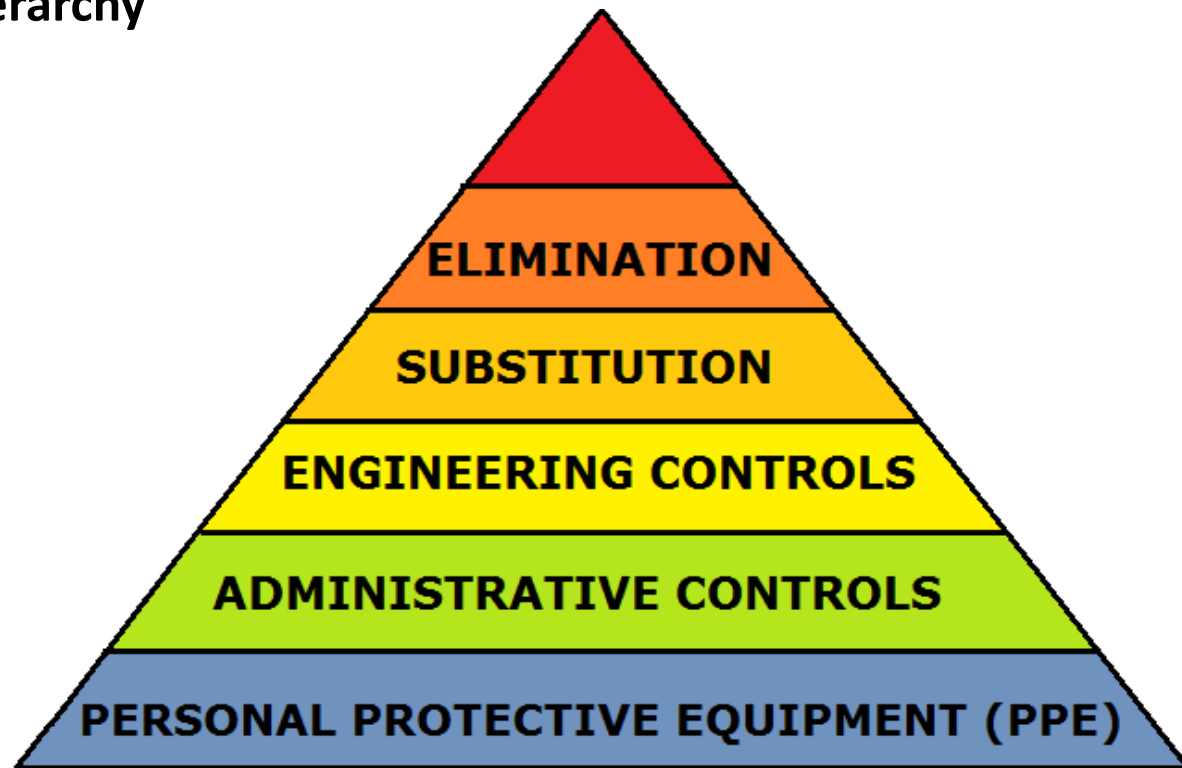
- **Activities at work that are dangerous and need special training and/or permit to perform, are referred as High Risk Activity (HRA).**
- **Depending on the job site, the activities may vary but some general HRAs are:**
  - **Driving (Including use of cell phone and seat belt)**
  - **Fall from heights**
  - **High-Pressure cleaning**
  - **Working with high temperature equipment**
  - **Confined space**
  - **Line breaks**
  - **Suspended loads**
  - **Powered industrial trucks**

## Review – Hazard Control

- Any potential source that may cause harm is a hazard.
- After identifying the hazard, the control methods should be applied accordingly.
- There are four types of hazard control methods:
  - Elimination or substitution
  - Engineering controls
  - Administrative controls
  - Personal protection equipment (PPE)
- The priority of using a control method is the same as sorted above.
- The most effective way of hazard control is eliminating the hazard permanently or at least substituting with a less hazardous equipment or material.

## Review – Hazard Control

### Hazard control hierarchy



## Review – Engineering Controls

- **Engineering hazard control has three types:**
  - **Ventilation**
    - At most of the workstation where there is a chance the worker may inhale debris, chemicals, etc. there should be specific ventilation system to ensure the contaminated air is removed.
  - **Process control**
    - Some processes need monitoring however the nature of the process might be so risky to harm people. Therefore, there should be specific designs just to enclose the process in a protected area and also monitor the process. These designated engineering designs have their own ventilation as well.
  - **Enclosure and/or Isolation**
    - It is important to isolate the emission source to prevent disasters. For instance, leak friendly surfaces are engineering designs that are meant to store the possibly leaking materials in a protected area.

## Review – Administrative Controls

- **Administrative hazard control is an important method of controlling hazards. Warning and safety signs in the workplace are examples of administrative controls. This type of control has 4 types:**
  - 1. Education and training**
    - Seminars about workplace safety
    - Raising awareness through social media
    - Frequent meetings about safety considerations
    - Creating case scenarios to place the employees in the situation
  - 2. Work practices and safety culture concept**
    - Safe work practices by everyone
    - Maintaining a solid reliable safety culture
    - Understanding the concepts of safe thinking
    - If possible, select a designated team with more training on emergency procedures.

## Review – Administrative Controls

3. **Personal and facility hygiene**
  - This prevents spreading unwanted biohazards
  - It also makes the workplace look clean and fresh
4. **Emergency response and preparedness**
  - Ensuring that employees are familiar with emergency responses



*Ref: Sign media, free sign, UK*

## Review – PPE

- **Personal protection equipment is the last line of defense. It is very important to wear the right PPE for different parts of workplace due to its nature of the job. Although using administrative methods, the appropriate for each workstation within the workplace should be listed, below are some suggestion for selecting the right PPE:**
  - **Identify hazards within the work area**
  - **Identify the possible harms may be resulted from those hazards**
  - **Select the appropriate PPE**
  - **Ensure proper fitting of the equipment**

## Review – Decision Making

- **Making an educated decision is a technique that requires some knowledge and it is very effective at workplaces. Studying the concepts of decision making will help appropriate instant deciding in emergency cases. Below are suggestions for making an educated decision:**
  1. **Identify a problem or opportunity**
    - **Recognizing a problem and identifying whether the problem is worthwhile to be solved is the first step.**
    - **What should be focused is the reality behind the issue and one can consider whether the decision can satisfy questions such as:**
      - **Will it make a difference?**
      - **How worthwhile will it be?**
  2. **Collect as much as information as possible**

## Review – Decision Making

### **3. Analyze the situation**

- Define the available alternative actions.
- Analyze whether the situation can be controlled by those alternatives.

### **4. Develop options**

- Develop several possible options for the situation.
- For each option, one can ask “what if” questions to determine the options are sufficient enough.

### **5. Evaluate the options and alternatives**

- Evaluate feasibility, acceptability and desirability.
- Determine the best alternative that will achieving the objective

## Review – Decision Making

A decision making matrix is a method that helps proper decision making based on the objectives one may have. Considering the example below with the following rates of cost (8), Safety (10), Durability (8) and Effectiveness (7):

	Cost	Safety	Durability	Effectiveness
Option 1: Do not change	10	2	1	1
Option 2: Brand new purchase	3	10	10	7
Option 3: Used purchase	5	7	6	4

Then the result for option 2 will be as follow:

$$(3 \times 8) + (10 \times 10) + (10 \times 8) + (7 \times 7) = 253$$

## Review – Risk Assessment

- **With the goal of eliminating potentially dangerous hazards, risk assessment is a method of protection by considering the risks of hazards and taking action accordingly.**
- **Below are some of the components that should be taken into account for conducting risk assessment.**
  - **Identification of hazards**
  - **Consideration of different circumstances such as power outage, shutdowns, emergencies and normal operational situations**
  - **Evaluation and monitoring of the risk to ensure it is under control**
  - **Evaluation of likelihood and severity of the injury or illness**
  - **Reviewing all the available health and safety information about the hazard such as MSDSs, manufacturers literature, results of testing, etc.**
  - **Keeping any necessary documentation or records that include the detailed risk assessment technique outlining evaluation details and conclusions.**

## Review – Risk Assessment

The Risk Matrix is also popularly known as the Probability and Impact Matrix. The Risk Matrix is used during Risk Assessment and is born during Qualitative Risk Analysis in the Risk Management process. It is a very effective tool that could be used successfully with Senior Management to raise awareness and increase visibility of risks so that sound decisions on certain risks can be made in context.

Risk Matrix

Very likely	Acceptable risk Low 2	Unacceptable risk High 3	Unacceptable risk Extreme 5
Likely	Acceptable risk Low 1	Acceptable risk Medium 2	Unacceptable risk High 3
Unlikely	Acceptable risk Low 1	Acceptable risk Low 1	Acceptable risk Medium 2
What is the chance it will happen?	Minor	Moderate	Major
	Impact How serious is the risk?		