

Risk Assessment & Management



Objectives

- Introduce the concept of risk assessment and risk management and its role.
- To define the principle components of risk management.
- To outline advanced risk assessment methodologies.
- To outline a practical risk assessment process.

Principals of Risk Management

Risk management can be defined as:

The eradication or minimisation of the adverse affects of risks to which an organisation is exposed.

Stages in Risk Management

- Identifying the hazards.
- Evaluating the associated risks.
- Controlling the risks.

RISK MANAGEMENT

RISK ASSESSMENT

Activity
Characterization



Hazard Identification



Risk Estimation



Option Analysis



Decision Making



RISK REDUCTION

Implementation



Monitoring



Audit & Review



General Regulations:-

- *‘Every Employer shall make a suitable and efficient assessment of:-*
 - a) The risks to the health and safety of his employees to which they are exposed whilst they are at work.*
 - b) The risks to the health and safety of persons not in his employment arising out of or in connection with the conduct by him or his undertaking;*
- *For the purpose of identifying the measures he needs to take to comply with the requirements and prohibitions imposed on him by or under the relevant statutory provisions.’*

Risk assessment can be a
*‘very straightforward process based on
judgement requiring no specialist skills or
complicated techniques.’*

This approach is commonly known as
qualitative or subjective risk assessment.

Major Hazards

- Major hazards associated with oil & gas, may *'warrant the need of such techniques as Quantitative Risk Assessment'*.
- In Quantitative Risk Assessment (**QRA**) a numerical estimate is made of the probability that a defined harm will result from the occurrence of a particular event.

The Risk Management Process

Hazard Identification

Hazard :

The potential to cause harm. Harm including ill health and injury, damage to property, installation, environment, production losses or increased liabilities.

Hazard Identification

- ***Comparative Methods***. e.g. checklists and audits.
- ***Fundamental Methods***: e.g. Deviation Analysis, Hazard and Operability Studies, Failure Modes & Effects Analysis.
- ***Failure Logic***: e.g. Fault Trees, Event Trees & Cause-Consequence diagrams

Assessing the Risks

Risk:

The likelihood that a specified undesired event will occur due to the realisation of a hazard by, or during work activities or by the products and services created by work activities.

Assessing the Risks

Quantitative risk assessment

- Commonly used in the high technology industries
- QRA tends to deal with the avoidance of low probability events with serious consequences to the installation and the surrounding environment.

Assessing the Risks

Subjective risk assessment

- Qualitative risk assessment involves making a formal judgement on the consequence and probability using:

$$\textit{Risk} = \textit{Severity} \times \textit{Likelihood}$$

Assessing the Risks

Example:

The likely **effect of a hazard** may for example be rated:

1. Major

Death or major injury or illness causing long term disability

2. Serious

Injuries or illness causing short-term disability

3. Slight

All other injuries or illnesses

Assessing the Risks

The **likelihood of harm** may be rated

1. High

Where it is certain that harm will occur

2. Medium

Where harm will often occur

3. Low

Where harm will seldom occur

Assessing the Risks

$$\begin{aligned} &\text{Risk} \\ &= \\ &\text{Severity of Harm} \\ &\times \\ &\text{Likelihood of occurrence} \end{aligned}$$

- *This simple computation gives a risk value of between 1 and 9 enabling a rough and ready comparison of risks.*
- *In this case the higher the number, the greater the risk, and so prioritises the hazards so that control action can be targeted at higher risks.*

Controlling Risk

- **Risk Avoidance** – This strategy involves a conscious decision on the part of the organisation to avoid completely a particular risk by discontinuing the operation producing the risk e.g. the replacing a hazardous chemical by one with less or no risk potential.
- **Risk Retention** – The risk is retained in the organisation where any consequent loss is financed by the company. There are two aspects to consider here, risk retention with knowledge and risk retention without knowledge.

Controlling Risk

- **Risk Transfer** – This refers to the legal assignment of the costs of certain potential losses from one party to another. The most common way is by insurance.
- **Risk Reduction** – Here the risks are systematically reduced through control measures, according to the hierarchy of risk control.

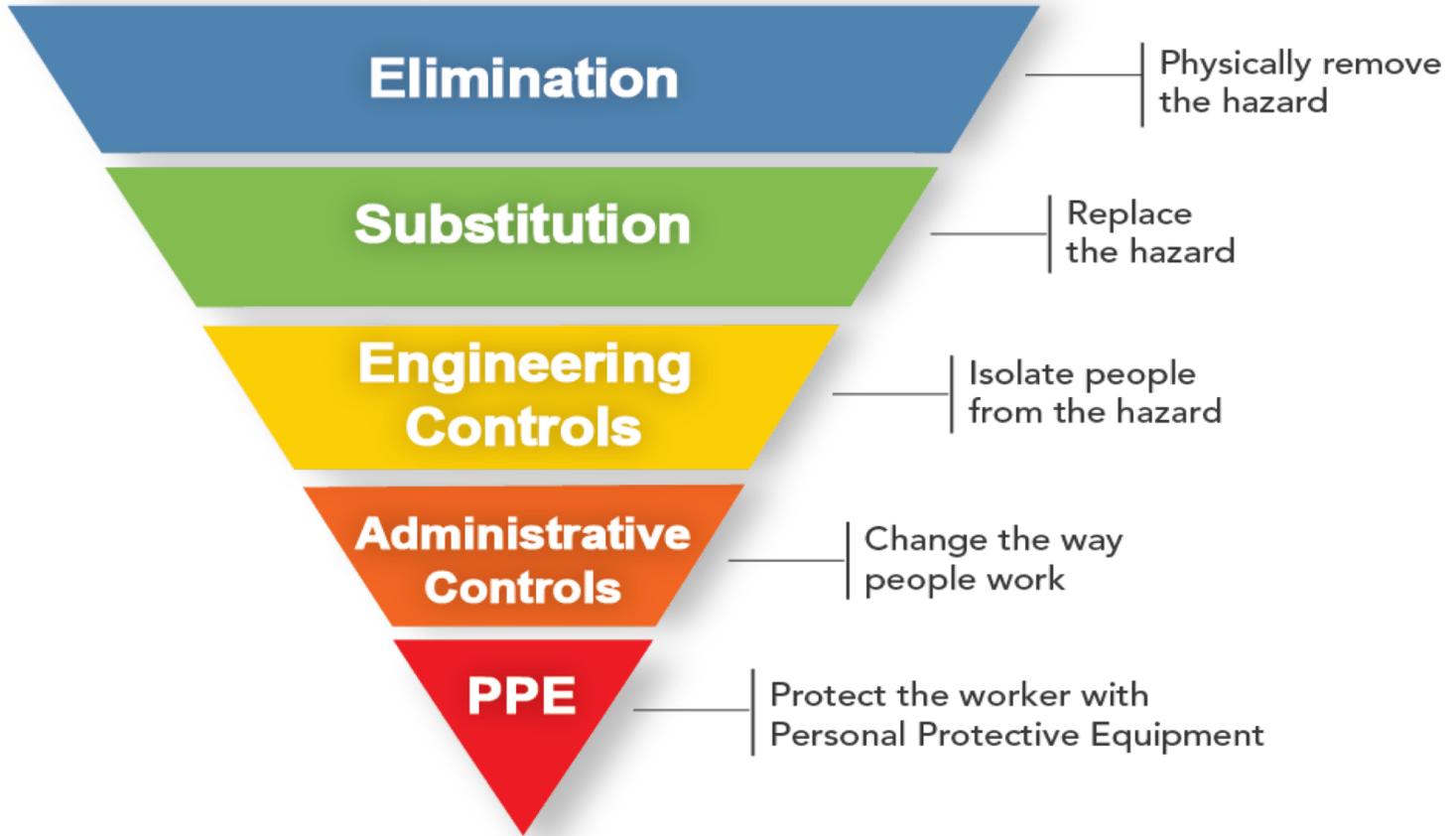
Controlling Risk

Hierarchy of Controls

Most effective



Least effective



ALARP

- Legislation requires employers to reduce risks to a level that is as low as is reasonably practicable (sometimes abbreviated as ALARP).
- To carry out a duty *so far as is reasonably practicable* means that the degree of risk in a particular activity or environment can be balanced against the time, trouble, cost and physical difficulty of taking measures to avoid the risk.

Types of Risk Assessment

Within Industry, three types of risk assessment can be distinguished:

- Assessments of large scale complex hazard sites, such as those found in hazardous industries. These require QRA's
- General assessments of the complete range of workplace risks – as required under the General Management of Health & Safety at Work Regulations.
- Risk Assessments required under specific legislation – for example for hazardous substances (COSHH Regulations), Manual Handling (Manual Handling Operations Regulations).

Advanced Risk Assessment Techniques

Quantitative Risk Assessment

- QRA is most commonly used in the process industries to quantify the risks of 'major hazards'.
- QRA used in the offshore oil and gas industries, the transport of hazardous materials and the protection of the environment.

Quantitative Risk Assessment – cont.

- **Individual Risk**

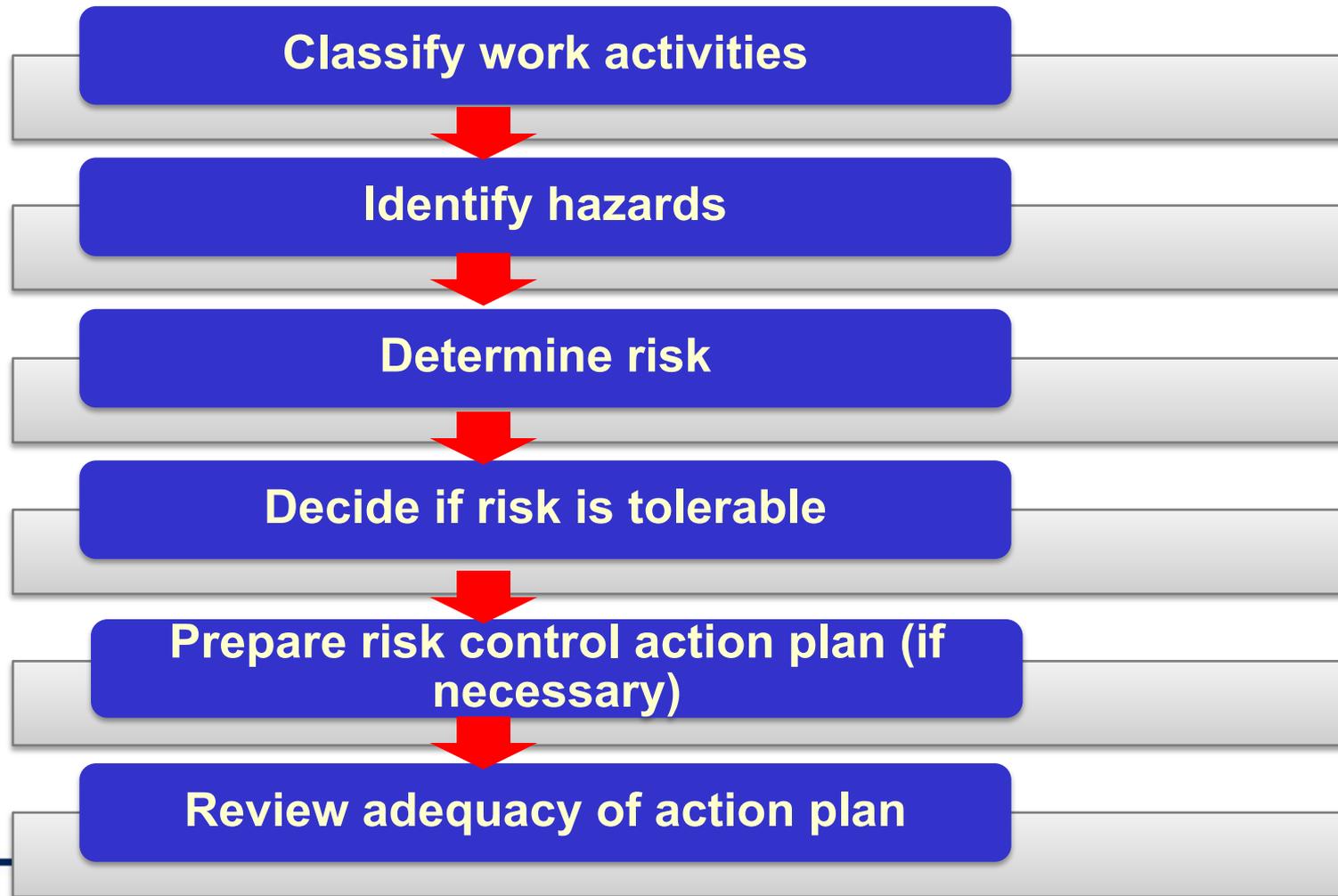
Is defined as ‘the frequency at which an individual may be expected to sustain a given level of harm from the realisation of specific hazards’.

- **Societal Risk** – usually expressed as risk contours

Quantitative Risk Assessment: Acceptance Criteria

- The HSE state that; *'broadly, a risk of death of 1 in 1000 (1×10^{-3}) per annum is about the most that is ordinarily accepted under modern conditions for workers in the UK and it seems to be the dividing line between what is tolerable and what is intolerable'*.

Practical Risk Assessment



Classify Work Activities

Possible ways of classifying work activities include:

- Geographical areas within/outside the organisation's premises.
- Stages in the production process, or in the provision of a service.
- Planned and reactive work.
- Defined tasks (e.g. welding).

Identify Hazards

Broad categories of hazard

To help with the process of identifying hazards it is useful to categorise hazards in different ways, for example by topic, e.g.:

- Mechanical.
- Electrical.
- Radiation.
- Substances.
- Fire and explosion.

Hazards prompt-list

During work activities could the following hazards exist?

- *Slips/falls on the level.*
- *Falls of persons form heights.*
- *Falls of tools, materials, etc., from heights.*
- *Hazards associated with manual lifting/handling of tools, materials, etc..*
- *Hazards from installation and machinery associated with assembly, commissioning, operation, maintenance, modification, repair and dismantling.*

Hazards prompt-list – cont.

- *Fire and explosion.*
- *Violence to staff.*
- *Substances that may be inhaled.*
- *Substances or agents that may damage the eye.*
- *Substances that may cause harm by coming into contact with, or being absorbed through, the skin.*
- *Substances that may cause harm by being ingested (i.e., entering the body via the mouth).*
- *Harmful energies (e.g., electricity, radiation, noise, vibration).*

Hazards prompt-list – cont.

- *Work-related upper limb disorders resulting from frequently repeated tasks.*
- *Inadequate thermal environment, e.g. too hot.*
- *Lighting levels.*
- *Slippery, uneven ground/surfaces.*
- *Inadequate guard rails or hand rails on stairs.*
- *Contractors' activities.*

Determine risk

The risk from the hazard should be determined by estimating the potential severity of harm and the likelihood that harm will occur.

Severity of Harm

Information obtained about work activities is a vital input to risk assessment. When seeking to establish potential severity of harm, the following should also be considered:

- Part(s) of the body likely to be affected;
- Nature of the harm, ranging from slightly to extremely harmful:
 - Slightly harmful, e.g.:
 - Superficial injuries; minor cuts and bruises; eye irritation from dust.
 - Nuisance and irritation (e.g. headaches); ill-health leading to temporary discomfort.

Severity of Harm – cont.

- Harmful, e.g.
 - Lacerations; burns; concussion; serious sprains; minor fractures.
 - Deafness; dermatitis; asthma; work related upper limb disorders; ill-health leading to permanent minor disability.
- Extremely harmful, e.g.
 - Amputations; major fractures; poisonings; multiple injuries; fatal injuries.
 - Occupational cancer; other severely life shortening diseases; acute fatal diseases.

Likelihood of Harm

When seeking to establish likelihood of harm the adequacy of control measures already implemented and complied with needs to be considered.

Issues considered:

- Number of personnel exposed.
- Frequency and duration of exposure to the hazard.
- Failure of services e.g. electricity and water.
- Failure of installation and machinery components and safety devices.
- Exposure to the elements.

Likelihood of Harm – cont.

- Protection afforded by personal protective equipment and usage rate of personal protective equipment;
- Unsafe acts (unintended errors or intentional violations of procedures) by persons, for example, who:
 - May not know what the hazards are.
 - May not have the knowledge, physical capacity, or skills to do the work.
 - Underestimate risks to which they are exposed.
 - Underestimate the practicality and utility of safe working methods.

Decide if risk is tolerable

One simple method for estimating risk levels and for deciding whether risks are tolerable. Risks are classified according to their estimated likelihood and potential severity of harm.

		Potential severity of harm		
		Slightly Harmful 1	Harmful 2	Extremely Harmful 3
Likelihood of harm occurring	Highly unlikely 1	Trivial 1	Tolerable 2	Moderate 3
	Unlikely 2	Tolerable 2	Moderate 4	Substantial 6
	Likely 3	Moderate 3	Substantial 6	Intolerable 9

A simple risk-based control plan.

Risk Level	Action & Timescale
Trivial	No action is required and no documentary records need to be kept.
Tolerable	No additional controls are required. Consideration may be given to a more cost-effective solution or improvement that imposes no additional cost burden. Monitoring is required to ensure that the controls are maintained.
Moderate	Efforts should be made to reduce the risk, but the costs of prevention should be carefully measured and limited. Risk reduction measures should be implemented within a defined time period. Where the moderate risk is associated with extremely harmful consequences, further assessment may be necessary to establish more precisely the likelihood of harm as a basis for determining the need for improved control measures.
Substantial	Work should not be started until the risk has been reduced. Considerable resources may have to be allocated to reduce the risk. Where the risk involves work in progress, urgent action should be taken.
Intolerable	Work should not be started or continued until the risk has been reduced. If it is not possible to reduce risk even with unlimited resources, work has to remain prohibited

Prepare risk control action plan

Risk categories shown form the basis for deciding whether improved controls are required and the timescale for action.

The outcome of a risk assessment should be an inventory of actions, in priority order, to devise, maintain or improve controls.

Prepare risk control action plan

The action plan should be reviewed before implementation, typically by asking:

- Will the revised controls lead to tolerable risk levels?
- Are new hazards created?
- Has the most cost-effective solution been chosen?
- What do people affected think about the need for, and practicality of, the revised preventive measures?
- Will the revised controls be used in practice, and not ignored in the face of, for example, pressures to get the job done?

Changing Conditions and Revising

Risk assessment should be seen as a continuing process. Thus, the adequacy of control measures should be subject to continual review and revised if necessary.
