Health and Safety Essentials

Lecture 8 – Risk Management Fundamentals

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Undergraduate Diploma in Occupational Health and Safety

Recap last week's topic

Kahoot Quiz:

https://play.kahoot.it/v2/*?quizId=da716beb-681e-49eb-846b-229609ea9387

Learning Objectives

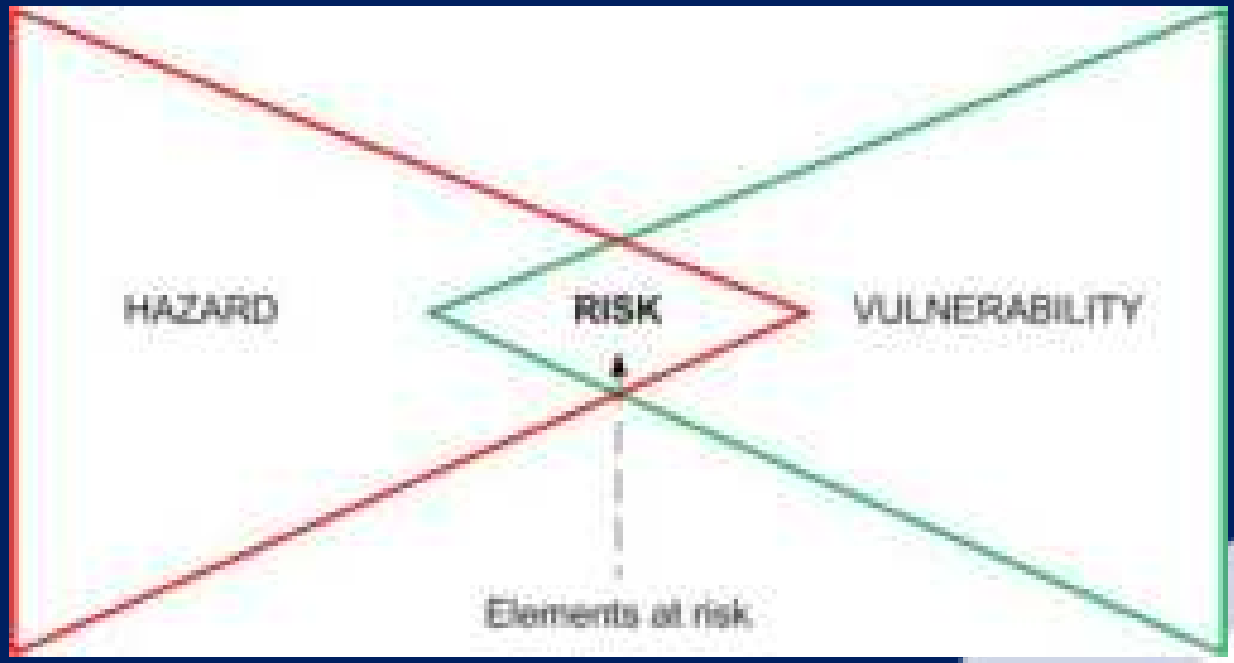
- Understand the fundamental concepts of risk, hazard, and safety in the context of OHS.
- Recognise the importance of balancing risk reduction with practicality and cost-effectiveness (ALARP).
- Learn to evaluate risks based on acceptability and tolerability frameworks, including economic risk criteria.
- Gain an understanding of key risk assessment tools such as:
  - Hazard and Operability Study (HAZOP).
  - Failure Modes and Effects Analysis (FMEA).
  - Fault Tree Analysis (FTA).
  - Event Tree Analysis (ETA).
- Explore human reliability in workplace systems and its impact on safety.
- Identify and quantify human errors, including performance shaping factors (PSFs).

What is Risk?

Simple Definitions:

- **Hazard:** Something with the potential to cause harm.
- **Risk:** Likelihood and severity of harm from a hazard.
- **Safety:** A condition where risks are controlled to an acceptable level.

No true satisfactory definition



Free From Risk?

- Absolute freedom from risk is impossible
- Safety exists on a spectrum defined by varying degrees of risk
- Need to address several critical aspects of safety and risk management, including:
  - How can we measure safety?
  - How can we determine the safety of a workplace or work activity?
  - How safe is safe enough?

To tackle these questions effectively, we must critically examine the concepts of risk, risk assessment, and risk management.

Perception of Risk

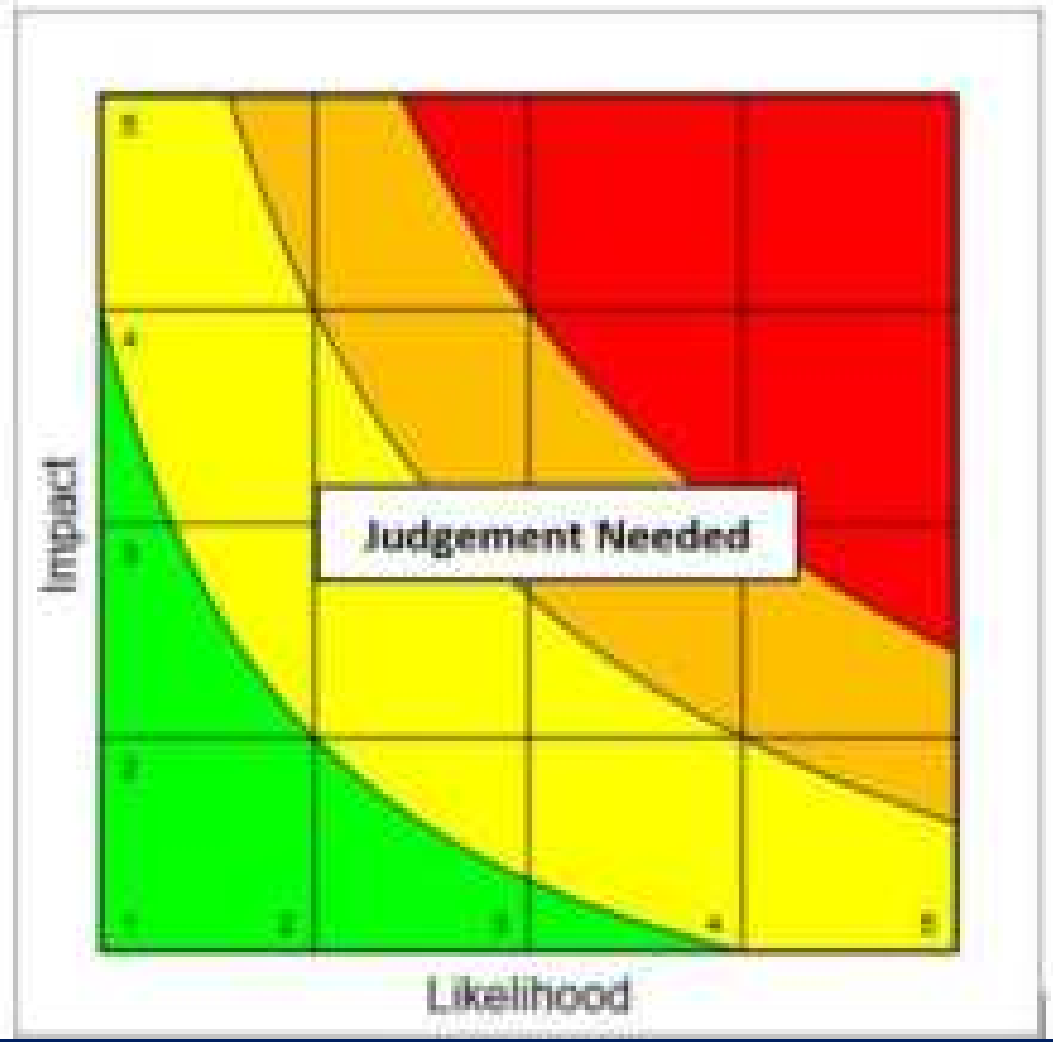
- A response to a risk depends on the perception of individuals, groups and nations.
- In a study by Slovic, Fischhoff and Lichenstein (1981), people were asked to judge the frequency of 41 causes of death.
  - Media affects people's perception of risk
  - Bias in people's perception often matched the bias in the media coverage
  - The less well-known risks tend to be perceived with fear and anxiety, for example, nuclear power,
  - everyday risks, such as road travel, are less of a worry.
  - Considerable influence of politics on risks – pressure from electorates can push parties to focus on an area, especially after a major, albeit infrequent, incident.

Acceptability of Risk

- The Council for Science and Society (1997) had the following statement as its first conclusion:

"The acceptability of risks cannot be simply derived from a scientific study of quantified probabilities, cost and benefits. The human factor influences the analysis at every point. But fairness in decisions and effectiveness in controls of risk can be approached by the use of scientific methods among others, provided that the diversity of human interests, values and perceptions of risks is always respected."

Acceptability of Risk



Risk =

Probability or Likelihood

×

Consequences or Impact

Risk Profiling

A **risk profile** helps a company understand its biggest health and safety issues. Every company will have its own unique risks, depending on:

1. What threats it faces.
2. How likely bad things are to happen.
3. What costs and problems those risks could cause.
4. How well the company is already managing those risks.

- By creating a risk profile, a company can focus its efforts on the most important risks and make sure they are using the right safety measures.

Risk Profiling – Risk Assessment Example

- A construction company wants to identify and manage risks at a building site.

1. **Hazard Identification:**
   The safety officer looks for hazards:
   1. **Falls from height**: Workers are using scaffolding and working on roofs.
   2. **Silica dust**: Cutting concrete and bricks releases fine dust that workers might breathe in.
   3. **Vibration**: Workers use jackhammers and other vibrating tools, which can cause long-term hand injuries.
2. The officer's experience helps them spot these hazards, but someone less experienced might miss the risks of silica dust or vibration.
3. **Likelihood and Severity:**
   1. **Falls from height**:
      1. **Likelihood**: Medium to high (workers are on scaffolding daily).
      2. **Severity**: Very high (falling could lead to serious injury or death).
   2. **Silica dust**:
      1. **Likelihood**: High (cutting happens often without dust control).
      2. **Severity**: High (long-term exposure can cause lung disease).
   3. **Vibration**:
      1. **Likelihood**: Medium (not all workers use vibrating tools).
      2. **Severity**: Medium (long-term injuries develop over time).

Risk Profiling – the Risk Profile Example

- The company creates a **risk profile** for the site:

1. **Main Risks:** Falls from height, silica dust, and vibration.
2. **Likelihood and Costs:**
    1. Falls are **likely** and could cause severe injury or death, leading to costly medical bills, delays, and fines.
    2. Silica dust exposure is **highly likely** and can cause serious long-term illnesses, increasing health insurance claims and potential lawsuits.
    3. Vibration injuries are **less likely** but can lead to chronic health issues, reducing productivity.
3. **Current Controls:**
    1. For falls: Workers wear harnesses, but scaffolding inspections are inconsistent.
    2. For silica dust: There's no dust extraction or proper PPE (e.g., masks).
    3. For vibration: Workers use the tools but don't rotate jobs to reduce exposure.

Risk Profiling – Prioritising Resources

- Based on the risk profile, the company decides:

1.Falls from height:

1. Inspect scaffolding daily.
2. Provide better training on harness use.

2.Silica dust:

1. Invest in dust extraction systems for cutting tools.
2. Require workers to wear proper respirators.

3.Vibration:

1. Rotate workers to limit exposure.
2. Purchase tools with lower vibration levels.

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What is the simple definition of 'Safety'

ⓘ Start presenting to display the poll results on this slide.

The Assessment of Risk

- Despite its importance, risk assessment is sometimes misunderstood or misused.
- It is occasionally reduced to a "tick-box" exercise, especially when conducted by individuals lacking a full understanding of the process or its purpose.
- Overuse or poor implementation can lead to complacency, undermining the effectiveness of risk assessments as a tool for hazard control.

The Assessment of Risk

- To ensure meaningful outcomes, risk assessments must follow a structured and logical approach. However, pitfalls often arise, such as:
  - Misinterpretation of risks.
  - A failure to align the assessment with the actual work environment.
  - Over-reliance on generic templates.

- A successful risk assessment involves:
  - Systematic identification of potential hazards.
  - Accurate estimation of the likelihood and severity of harm.
  - Implementation of proportionate control measures to reduce risks.

Understanding Hazards and Their Consequences

Failures in safety systems often reveal that early warning signs of hazards were either overlooked or not addressed due to the absence of a systematic approach to identifying and analysing hazards. Therefore, hazard identification should be an integral component of any safety management system.

- **Key activities in hazard identification include:**
  - Investigating accidents and illnesses to understand their root causes.
  - Conducting systematic safety analyses
  - Undertaking epidemiological surveys to assess trends and risks.

Obtaining Information

Effective hazard identification, risk evaluation, and control measures depend on the availability of reliable and accurate information.

- Internal sources of information might include:
  - Workplace inspections and audits.
  - Accident and incident reports.
  - Employee feedback and health records.

- External sources could encompass:
  - Industry standards and guidelines.
  - Research studies and scientific data.
  - Regulations and reports from health and safety authorities.

Cost versus Benefit

The goal of safety management is not to eliminate all accidents, an impossible task, but to reduce risks to an acceptable level.

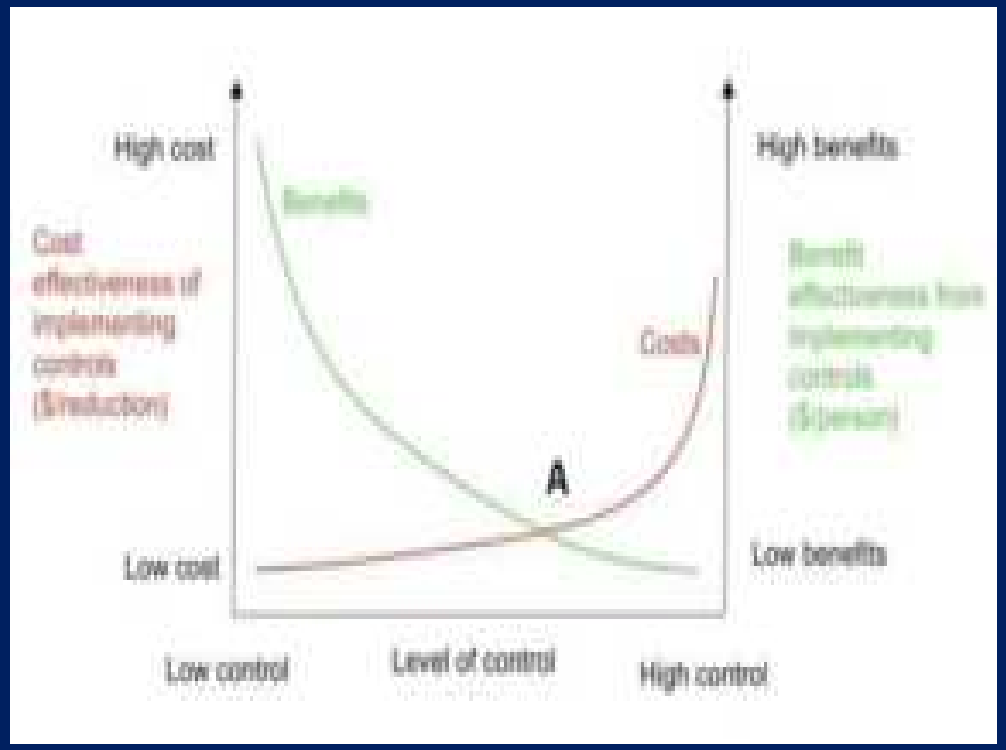
- Determining this level involves key questions:
  - Who decides what is "acceptable"?
  - Should cost considerations influence these decisions?
  - How do we know when a risk level is low enough?

Cost Benefit Analysis

Cost Benefit Analysis (CBA) is a key tool used to determine whether risk control measures are justifiable. The principle of "reasonably practicable" requires weighing the cost and effort of implementing controls against the level of risk reduction they achieve. This balance is illustrated in scenarios where:

- A significant risk, such as the potential for limb loss from a machine, justifies the expenditure on safeguards.
- Minor risks, such as a small cut, may not warrant significant spending on additional controls.

Cost Benefit Analysis



- The HSE (1997) describes a point, known as Point A, beyond which further investment in safety measures no longer produces a worthwhile return. This point is reached when additional controls fail to significantly reduce risk while continuing to incur costs. The concept applies to measures ranging from single safety procedures to comprehensive safety management systems.

Break

Breakout Room

- **Statement for Discussion:** "A response to a risk depends on the perception of individuals, groups, and nations.
- **Context:** In the Risk Profiling Example of a Construction Site, we identified:
  - **Falls**
  - **Silica Dust Exposure**
  - **Vibration Injuries**

In Malta, exposure to silica dust and vibration are often not considered high hazards. This suggests that perceptions of risk vary significantly based o cultural, social, and regulatory factors.

Breakout Room

- **Task (10-15 minutes):**

1.Discuss the Statement:

1. Do you agree that responses to risk depend on perception?
2. How might individuals, groups, or nations view the hazards of silica dust and vibration differently?
3. What influences these perceptions (e.g., culture, regulations, awareness)?

2.Scenario Comparison:

1. Compare Malta's approach to silica dust and vibration hazards with what you believe might occur in other countries (e.g., stricter enforcement in the EU or the UK).
2. How might these differences impact safety outcomes?

3.Key Question for Group Output:

- What actions could improve the perception and prioritisation of silica dust and vibration hazards in Malta?

Economic Risk Criteria

- Economic risk criteria provide an objective framework for evaluating the potential financial impact of workplace risks and determining whether these risks are acceptable. This analysis assesses:
  - The cost of accidents or damage (e.g., injury compensation, equipment repairs).
  - The frequency of these losses.
  - Whether the cumulative impact is tolerable.

- Insurance may cover some costs, such as injury claims or equipment damage, other losses, including production downtime or material wastage, can be more substantial and may not be insured. Understanding these costs in advance is essential for informed decision-making.


DIRECT VS INDIRECT COST OF AN ACCIDENT
WHAT PEOPLE SEE
DIRECT COST
-MEDICAL EXPENSES
-LOST WAGES
-SICK PAY LEAVES
-WORKERS' COMPENSATION
-COSTS OF PROPERTY DAMAGE
-LEGAL COSTS
WHAT PEOPLE DON'T SEE
INDIRECT COST
-REDUCED PRODUCTIVITY
-OVERTIME PAYMENTS
-REDUCED QUALITY
-INCREASED INSURANCE PREMIUMS
-REPUTATION DAMAGE
-REDUCED EMPLOYEE MORALE
-HIGHER TURNOVER RATES
-HIRING EFFORTS FOR REPLACEMENT
-TRAINING COSTS
-TIME LOSS IN INVESTIGATIONS
-THE COST OF CLEANING UP
-RESTORATION TIME OF EQUIPMENT
Safety Pedia

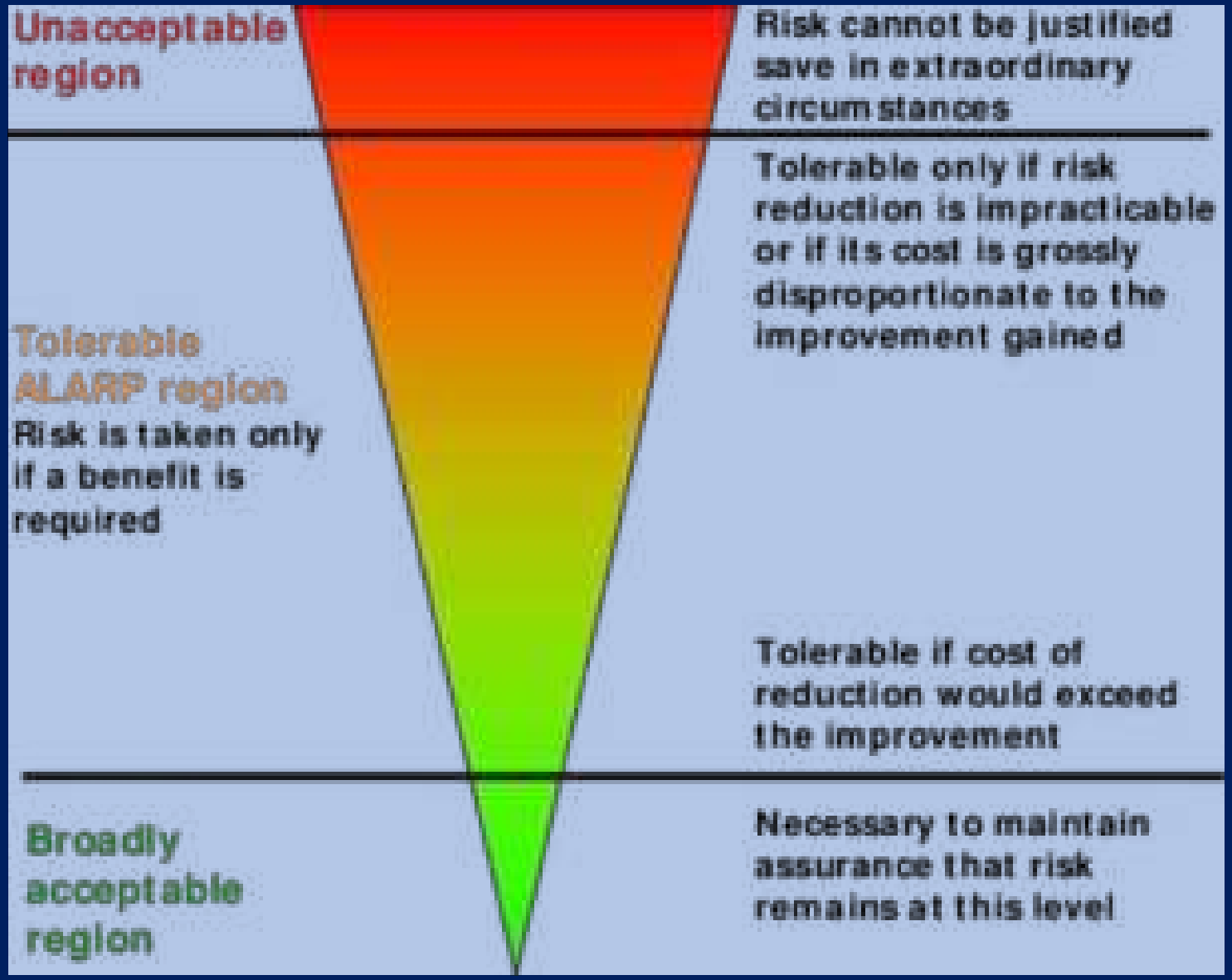
Tolerable Risk

- The concept of tolerable risk refers to risks that we are willing to live with in order to gain certain benefits, provided they are effectively controlled and regularly reviewed.
- The concept of tolerable risk, managed to be As Low As Reasonably Practicable (ALARP), is integral to risk management across various industries.
- The ALARP shall be applied in the context of the respective national OHS legislative framework.

Tolerability of Risk

- The Health and Safety Executive (HSE) defines this concept through the Tolerability of Risk (TOR) framework, originally developed for industries like nuclear power. According to this framework:
  - The maximum tolerable risk for workers in any industry is set at a 1 in 1,000 chance of fatality per year.
  - For the general public exposed to industrial hazards, this threshold is reduced to 1 in 10,000.
  - Acceptable levels, such as for communities living near nuclear power plants, are much lower, often at 1 in 1,000,000.

ALARP


Unacceptable region
Risk cannot be justified save in extraordinary circumstances
Tolerable only if risk reduction is impracticable or if its cost is grossly disproportionate to the improvement gained
Tolerable ALARP region
Risk is taken only if a benefit is required
Tolerable if cost of reduction would exceed the improvement
Broadly acceptable region
Necessary to maintain assurance that risk remains at this level

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What does ALARP stand for?

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Risk Evaluation

- Risk evaluation is a critical step in safety management, building on the principles of acceptability and tolerability of risk. This process involves assessing the relationship between exposure to a hazard and its potential outcomes. The goal is to determine whether risks are at acceptable or tolerable levels and to implement measures to reduce them where necessary.

Risk Evaluation

- The following outline specific tools and methodologies that elevate risk evaluation to a more formalised level. These include:
  1. Hazard and Operability Studies (HAZOP).
  2. Hazard Analysis (HAZAN).
  3. Failure Modes and Effects Analysis (FMEA).
  4. Fault Tree Analysis (FTA).
  5. Event Tree Analysis (ETA).
  6. Probabilistic Risk Assessment (PRA).

Hazard and Operability Studies (HAZOP):

- **What it is:** A detailed look at a system or process to find anything that could go wrong or work differently than intended.
- **How it works:** A team examines every part of the process step by step, asking questions like, “What if this fails?” or “What if conditions change?”
- **Example:** In a factory, checking if a valve fails to open or if a machine runs too fast.

Hazard Analysis (HAZAN)

- **What it is:** A process to figure out how likely a hazard is to happen and how serious it would be.
- **How it works:** It focuses on a specific hazard, estimating the likelihood and severity to decide if it's acceptable or needs control measures.
- **Example:** Analyzing how likely a chemical spill is and the damage it could cause.

Failure Modes and Effects Analysis (FMEA)

- **What it is:** A method to find all the ways something could fail and what effects those failures would have.
- **How it works:** Teams think of potential failures, their causes, and their impact, then rank them to focus on the most critical ones.
- **Example:** Checking how a car's braking system might fail, like a fluid leak, and the danger it could cause.

Fault Tree Analysis (FTA)

- **What it is:** A diagram-based method that shows how smaller failures can combine to cause a big problem.
- **How it works:** Start with a problem (like a fire) at the top, then map out the possible reasons (like a gas leak or electrical fault).
- **Example:** Understanding what might cause an airplane engine to fail.

Event Tree Analysis (ETA)

- **What it is:** A diagram that shows what might happen after an event, including both good and bad outcomes.
- **How it works:** Start with one event (like a machine breakdown) and map out possible consequences (like delays, injuries, or repairs).
- **Example:** Mapping what could happen after a fire alarm goes off—will sprinklers activate? Will people evacuate?

Probabilistic Risk Assessment (PRA)

- **What it is:** A method to calculate the overall risk by combining the likelihood of many events and their impacts.
- **How it works:** It uses data and probabilities to figure out the chance of something bad happening and its potential consequences.
- **Example:** Estimating the overall risk of a power plant failure by considering all possible issues (like equipment breakdowns and human errors).

Human Reliability

Covered in the last lecture.

- Human beings are each unique, having their own characteristics based upon individual personalities, physical differences and cultural backgrounds.
- Taken together, these factors form some of the inputs that determine each individual's perception of risk and the circumstances that result in a range of ways behaviour leads to human error and what people do in the face of danger that may be encountered in the workplace.

Human Reliability

- Human error is considered a contributing cause in **80-90%** of major accidents.
- Human reliability analysis aims to quantify the likelihood of human error and incorporate it into overall risk assessments. Techniques include:
  - **Task Analysis:** Breaks down tasks to identify potential error points and evaluates how these errors might impact the system.
  - **Performance Shaping Factors (PSFs):** Considers conditions such as stress, workload, and environmental factors that influence human performance.
  - **Recovery Factors:** Recognises the ability of individuals to detect and correct their own errors before they escalate, an important overlooked in analyses. aspect often

Human Reliability

- Probabilities are assigned to human errors using statistical data or expert judgment. For example:
  - In complex, high-pressure situations, human error rates are higher (e.g., 1 in 10 under stress).
  - Routine tasks have lower error rates (e.g., 1 in 1,000 for familiar activities in a controlled environment).

Breakout Room (optional)

- **Scenario for Discussion: Machine Guarding**
- You are evaluating a workplace scenario involving a 40 year old machinery with moving parts. Risks include:
  1. **Risk of hand entanglement**, potentially leading to serious injury.
  2. **Risk of slipping near the machine**, causing minor cuts or bruises.

- The current control measures include:
  - Basic signage to warn employees about the machine hazards.
  - A partial guard covering part of the machinery.

Breakout Room (optional)

- **Tasks (10-15 Minutes):**

1. **Evaluate the Scenario**:
    1. Are the risks reduced to ALARP?
    2. What additional control measures could be implemented? (e.g., full guarding, enhanced training, floor marking).
    3. Would the benefits of additional measures justify their cost and effort?
2. **Group Discussion**:
    1. What are the key factors influencing your decision (e.g., severity, likelihood, cost)?
    2. Consider how your response might vary if this were a small business versus a large corporation.

- **Output:**
- Each group prepares:
    - A brief explanation of whether you believe the risks are ALARP.
    - 2-3 additional control measures you would recommend, if any.
    - Rationale for your decisions (e.g., cost-benefit, practicality).

Recap

- Risk cannot be totally eradicated
- ALARP and TOR
- Tools like HAZOP, FMEA, FTA, and ETA.
- Importance of structured risk management approaches.
- The role of human reliability in preventing incidents.

21 ACADEMY

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