Analyzing, Assessing and Minimizing the Risks from Hazards I

Lecture # 8

Ms. Sadia Tariq

Risk

- Risk is defined as:

"The chance or probability that a person will be harmed or experience an adverse health effect if exposed to a hazard."

- ISO 45001 defines Risk as:

"The effect of uncertainty"

- Risk is often expressed in terms of a *combination of the severity and consequences* of an event (including changes in realities) and likelihood or occurrence.

- Risk is commonly *a multiple of severity and occurrence*.

(Risk = Severity x Occurrence)

5x5 Risk Matrix

Impact

How severe would the outcomes be if the risk occurred?

Probability

What is the probability the risk will happen?

	Insignificant 1	Minor 2	Significant 3	Major 4	Severe 5
5 Almost Certain	Medium 5	High 10	Very high 15	Extreme 20	Extreme 25
4 Likely	Medium 4	Medium 8	High 12	Very high 16	Extreme 20
3 Moderate	Low 3	Medium 6	Medium 9	High 12	Very high 15
2 Unlikely	Very low 2	Low 4	Medium 6	Medium 8	High 10
1 Rare	Very low 1	Very low 2	Low 3	Medium 4	Medium 5

5x5 Risk Matrix

- A type of risk matrix that is visually represented as a table or a grid, a 5x5 risk matrix has 5 categories each for probability (along the X axis) and impact (along the Y axis), all following a scale of low to high.
- It is a comprehensive tool used by organizations during the risk assessment stage of project planning, operations management, or job hazard analysis.
- A 5x5 risk matrix aims to identify the probability and impact levels of injury and risk exposure to a worker in relation to workplace hazards.
- It can serve as a supplementary tool in evaluating the possible damage or disruption brought about by risks.
- Color-coding is crucial for a 5×5 risk assessment matrix to represent the combination level of probability and impact of the identified risks. That said, high risks must be in red, moderate risks in yellow (amber), and low risks in green.
- Organizations, EHS professionals, and project managers can then use other closely-related colors, such as orange, light red, and light green, to differentiate the specific risk ratings.
- A 5×5 risk matrix also aims to answer the question:

"What are the 5 risk rating levels in the risk assessment matrix?"

A 5×5 risk matrix has two axes, or components to put it simply, that make up the whole table or grid:

- The Probability and
- The Impact

Probability

- Also called likelihood, the Probability (x axis) pertains to the extent of how likely it is for the risk to occur. The 5 risk rating levels under this component are as follows:

1) **Rare** – unlikely to happen and/or have minor or negligible consequences
2) **Unlikely** – possible to happen and/or to have moderate consequences
3) **Moderate** – likely to happen and/or to have serious consequences
4) **Likely** – almost sure to happen and/or to have major consequences
5) **Almost certain** – sure to happen and/or have major consequences

Impact

- Also called severity or consequences, the Impact (y axis) aims to determine the level of effects that the hazard can cause to workplace health and safety.

- While a 5×5 risk matrix can be tailored to the needs of an organization, the following represent the general terms used to describe the 5 levels to determine the risk's impact:

1) **Insignificant** – won't cause serious injuries or illnesses
2) **Minor** – can cause injuries or illnesses, only to a mild extent
3) **Significant** – can cause injuries or illnesses that may require medical attention but limited treatment
4) **Major** – can cause irreversible injuries or illnesses that require constant medical attention
5) **Severe** – can result to fatality

- Each risk box represents the rating of a risk that is calculated based on its particular levels of probability and impact. In most cases, the 5×5 risk matrix uses numeric values to better represent the risk ratings.

Calculating Risks Using the 5×5 Risk Matrix

Probability x Impact = Risk Level

- The first step is to assign a numeric value from 1 to 5, 1 being the lowest, for each of the categories under Probability and Impact. Then, use the formula of multiplying the value of the Probability to the value of Impact to determine the Risk Level.

To better understand how the various levels indicate the Probability and Impact, here's a guide on the numeric values and their representation as a result of the analysis:

- **1-4: Acceptable** – no further action may be needed and maintaining control measures is encouraged
- **5-9: Adequate** – may be considered for further analysis
- **10-16: Tolerable** – must be reviewed in a timely manner to carry out improvement strategies
- **17-25: Unacceptable** – must implement cease in activities and endorse for immediate action

Risk Analysis

- Risk analysis is defined as:

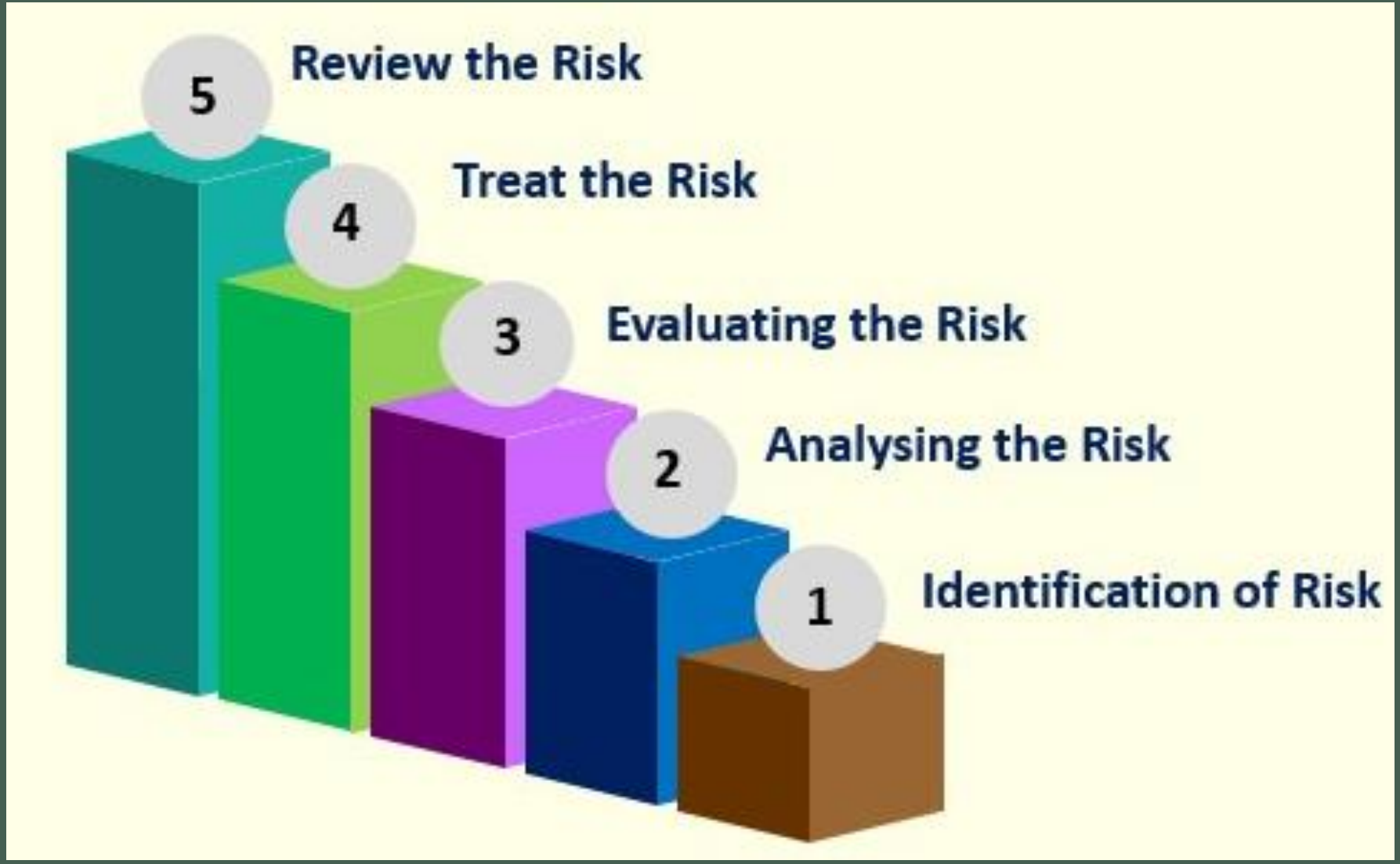
"The process of identifying and analyzing potential issues that could negatively impact key business initiatives or projects".

OR

"The assessment process that identifies the potential for any adverse events that may negatively affect organizations and the environment".

- Risk analysis is commonly performed by corporations (banks, construction groups, health care, etc.), governments, and nonprofits.
- Conducting a risk analysis can help organizations determine whether they should undertake a project or approve a financial application, and what actions they may need to take to protect their interests. This type of analysis facilitates a balance between risks and risk reduction.
- Risk analysts often work in with forecasting professionals to minimize future negative unforeseen effects.

Process of Risk Analysis



❖ ***Identification of Risk:***

The First step comes as identifying the risk. Team members shall gather all the inputs that shall be used in the projects and recognize the outcome of the projects and the number of ways such as risk involved in the process, etc.

❖ ***Analyzing the Risk:***

After identifying risk, it's likely to understand and assess the extent of risk and nature of risk that most likely to happen and to what extent it may occur to the organization shall be analyzed.

❖ ***Evaluating the Risk:***

Analyzing risk helps you to estimate the capacity of risk that may happen. Hence in evaluating the risk, the team shall rank the calculated risk to decide whether to accept such risk or not.

❖ ***Treat the Risk:***

In this step, the team shall decide whether to continue the project or not; if so, the project is accepted, then they shall try to treat or resolve the issue by modifying any changes required in the project.

❖ ***Review the Risk:***

As the risk is uncertain at any point in time, reviewing risk is essential to evaluate risk in the project from time to time to avoid any future disturbance.

Methods of Risk Analysis

There are 2 methods of Risk Analysis:

- Quantitative risk analysis
- Qualitative risk analysis

❖ ***Quantitative Risk Analysis:***
It uses mathematical models and simulations to assign numerical values to risk.

❖ ***Qualitative Risk Analysis:***
It relies on a person's subjective judgment to build a theoretical model of risk for a given scenario.

Qualitative Vs. Quantitative Risk Analysis

Basics	Qualitative Risk Analysis	Quantitative Risk Analysis
Concept	It is a subjective approach and primary objective is to identify severity of risks.	It is objective approach that uses verified data and statistical tools to analyse risk and impact
How it is performed?	Ranks the risk on a scale of 0 to 1	Considers risks closer to 1 to calculate risk
What it does?	Assesses likeliness of risk to inform team about which is to be addressed first	Uses numerical calculations to determine risk and its impact
Complexity	More complex a no tools to assist	Less complex as tools are available to assist
Time Consuming	More time consuming	Less time consuming
When to perform?	At start of every new project	When there is loads of data on the risk
Suitability	All kinds of projects	Complex projects
Volume of Risk	Considers all the risks	Considers important risk marked by qualitative risk analysis

RISK ANALYSIS METHODS

- ❑ Helps an entity identify risks & potential threats to its processes & operations
- ❑ Gives idea of their severity & likelihood of occurrence

TYPES

QUALITATIVE RISK ANALYSIS METHODS

1. **Bow Tie Analysis** – Spilt risk into two parts contributing factors and potential consequences
2. **The Delphi Technique** – Depends mainly on expert comments
3. **SWIFT Analysis** - Analyses how changes to new plan or design would impact potential project
4. **Fly Analysis** – Find causes and result of happening event

QUANTITATIVE RISK ANALYSIS METHODS

1. **Monte Carlo Simulation** - Determine chances of an event
2. **Decision Tree Analysis** - Graphical method where all possible scenarios are depicted visually
3. **Sensitivity Analysis** - Check impact of small change on final result
4. **Three-Point Estimate** -Estimation of cost and duration
5. **FMEA** – Failure modes and its determination

Pros and Cons of Risk Analysis

Pros

- May aid in minimizing losses due to management preemptively forming a risk plan
- May allow management to quantify risks and assign dollars to future events
- May protect company resources, produce better processes, and mitigate overall risk

Cons

- Relies heavily on estimates, so it may be difficult to perform for certain risks
- Can not predict unpredictable, black swan events
- May underestimate risk magnitude or occurence, leading to overconfident operations

Risk Assessment

- Risk assessment is defined as:

"A risk management process which involves identifying potential hazards and analyze what could happen if the hazard results to an accident".

OR

"The determination of quantitative or qualitative estimate of risk related to a well-defined situation and a recognized threat hazard".

- Quantitative risk assessment requires calculations of two components of risk *(R)*:

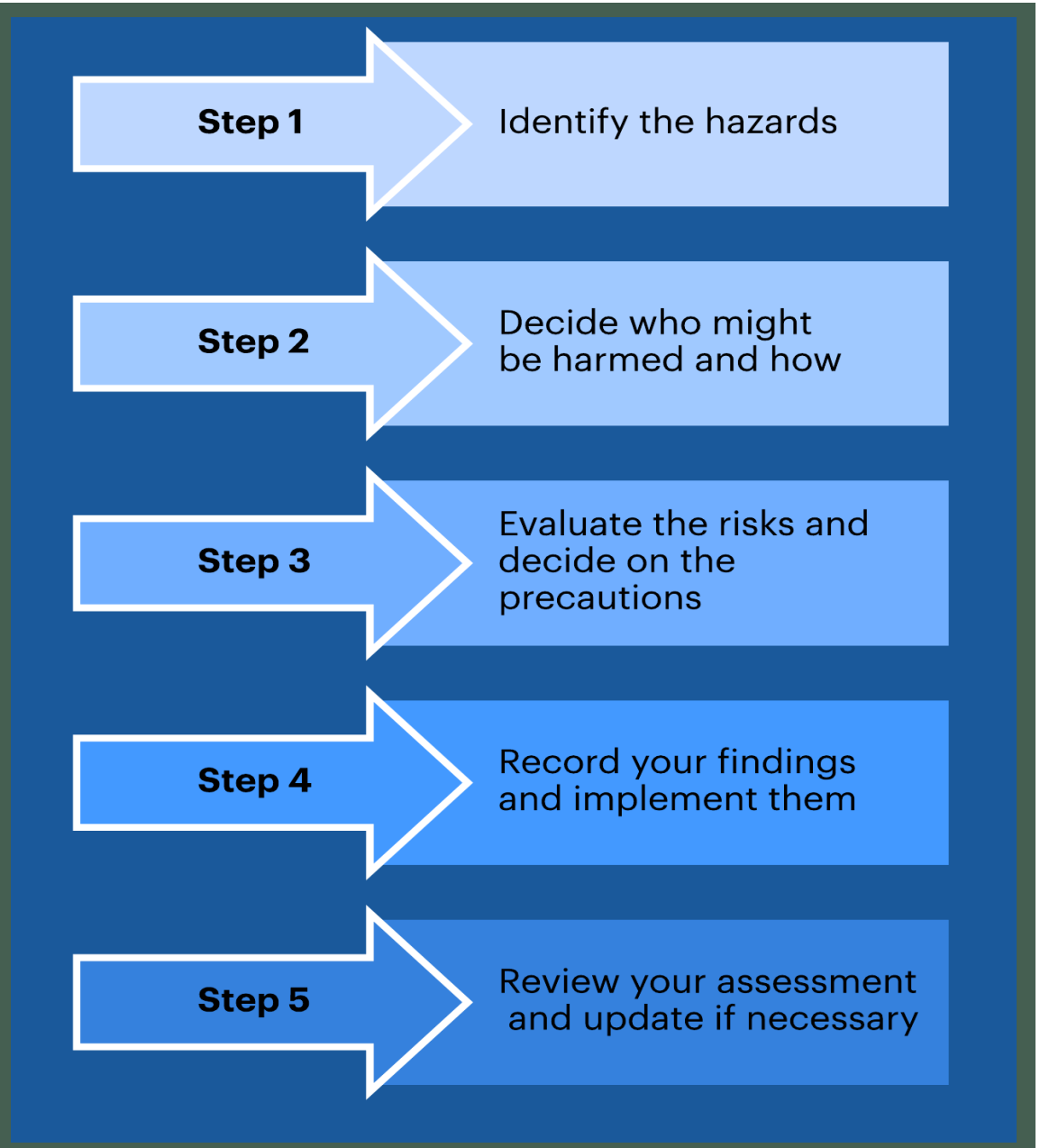
- The magnitude of the potential loss *(L)*,
- The probability *(p)* that the loss will occur.

Why Is Risk Assessment Important?

Risk assessments are very important as they form an integral part of a good occupational health and safety management plan. They help to:

- Create awareness of hazards and risks.
- Identify who may be at risk (employees, cleaners, visitors, contractors, the public, etc.).
- Try and determine if existing control measures are adequate or if more should be done.
- Prevent injuries or illnesses when done at the design or planning stage.
- Prioritize hazards and control measures.

Risk Assessment Steps



Goal of Risk Assessment

The aim of the risk assessment process is to evaluate hazards, then remove that hazard or minimize the level of its risk by adding control measures, as necessary. By doing so, you have created a safer and healthier workplace.
The goal is to try to answer the following questions:

1) What can happen and under what circumstances?
2) What are the possible consequences?
3) How likely are the possible consequences to occur?
4) Is the risk controlled effectively, or is further action required?

When Should A Risk Assessment Be Done?

There may be many reasons a risk assessment is needed, including:

- Before new processes or activities are introduced.
- Before changes are introduced to existing processes or activities, including when products, machinery, tools, equipment change or new information concerning harm becomes available.
- When hazards are identified.

Risk Estimation

- Risk estimation (also referred to as risk characterization) is the final step in risk assessment.
- Risk assessment is the identification of hazards that could negatively impact an organization's ability to conduct business.
- Its goal is to produce measures of the health, safety, and environmental risks that are being assessed.
- These assessments help identify these inherit business risks and provide measures, processes and controls to reduce the impact of these risks to business operations.

Risk Estimation Methods

All risk estimation methods are based on the general equation of the risk:

$$R = f \times p \times c$$

Where:

R = Risk Assessment
f = Human Error or Equipment Failure
p = Safety Barriers
c = Consequences