

Risk Management in Practice

Lecture 5 : Risk Assessment Methodologies Qualitative Approach

Lecturer: Jean Paul Xuereb
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Undergraduate Diploma in
Occupational Health and Safety

Lecture Aim

- Understand how when and how to apply a qualitative Risk Assessment Methodology to manage Risks at the Workplace

This lecture aims to develop learners' understanding of workplace risk by introducing practical qualitative risk assessment tools used to identify and prioritise hazards. Students will explore how likelihood and severity are used together to form risk judgments and how informed decision-making supports safer working environments. The session emphasises the importance of consistent and transparent reasoning, showing how experience, perception, and available evidence influence risk ratings. By the end of the lecture, learners will be able to apply qualitative tools confidently, interpret risk levels clearly, and support effective risk control planning that aligns with recognised safety practices and organisational standards



Lecture Objective

1. A Qualitative risk assessment uses structured judgement to evaluate hazards by describing likelihood and severity rather than relying on numerical data or calculations.
2. Use a 5×5 risk matrix - A 5×5 risk matrix visually combines likelihood and severity levels to rank risks consistently and support clear prioritisation decisions.
3. Assign likelihood and severity ratings - Likelihood and severity ratings are selected using agreed definitions, considering exposure, potential harm, existing controls, and professional experience.
4. Interpret risk levels- Risk levels indicate priority for action, guiding whether risks require immediate controls, planned improvements, or continued monitoring



What is a Risk ?

- Hazard: potential source of harm
- Risk: chance and severity of harm
- Risk combines likelihood and severity



Qualitative Risk Assessment

Qualitative risk assessment is a judgement-based approach used to evaluate workplace hazards by considering how likely an incident is to occur and how severe the consequences could be. Instead of relying on precise numerical data, it uses descriptive categories such as rare, possible, or likely for likelihood, and minor, moderate, or major for severity. This method is widely used in workplace risk management because it is practical, easy to apply, and effective where detailed statistical data may be unavailable. It supports clear communication, consistent decision-making, and prioritisation of control measures

- Judgement-based approach- Relies on professional experience, observation, and informed opinion to evaluate workplace hazards and potential risks effectively.
- Uses descriptive categories- Applies clear terms such as likely or severe to describe risk levels instead of complex numerical data.
- Common in workplace risk management -Widely used due to simplicity, practicality, and suitability for everyday workplace safety assessments.



Why use Qualitative Risk Assessment Approach

- Simple and easy to understand for all workers and managers
- Effective when limited or no statistical data is available
- Encourages discussion and awareness of workplace hazards
- Supports quick decision-making in everyday work activities
- Promotes consistent risk ranking using standard definitions
- Widely accepted within workplace safety management systems



Key Features in a Qualitative Risk Assessment Approach

- Uses likelihood and severity to evaluate risk
- Relies on descriptive categories rather than precise calculations
- Applies risk matrices to rank and prioritise hazards
- Incorporates professional judgement and experience
- Considers existing control measures
- Supports consistent and transparent decision-making
- Easy to communicate across all workforce levels
- Suitable for routine and non-complex workplace activities



Understanding Likelihood

- In occupational health and safety, likelihood refers to the probability that a hazardous event will occur during work activities. Understanding likelihood involves considering how often workers are exposed to a hazard, how long the exposure lasts, and how effective existing control measures are. Past incidents, near misses, and workplace conditions also influence likelihood judgments. By carefully evaluating these factors, assessors can make informed and consistent decisions about how probable an incident is, supporting accurate risk ratings and effective control planning.
1. Frequency of exposure to the hazard
 2. Duration of exposure during tasks
 3. Number of people exposed
 4. History of incidents or near misses
 5. Effectiveness of existing controls
 6. Workplace conditions and



Likelihood (Probability) Scale

Likelihood Scale

Rating Score	Qualitative Element	Definition
0	Impossible	No injury or illness, damage or other loss is possible.
1	Improbable	Loss, injury or illness could only occur under freak conditions. The situation is very well managed, and all reasonable precautions have been taken.
2	Unlikely	The situation is generally well managed; however occasional lapses could occur. This also applies to cases where people are required to behave safely to protect themselves but are well trained.
3	Likely	Insufficient or substandard controls in place. The loss is unlikely during normal operation; however, it may occur in emergencies or non-routine conditions.
4	Very Likely	Serious failures in management controls. The effects of human behavior or other factors could cause an accident but are usually supported with this additional factor (e.g. ladder not appropriately secured, process upset, oil spilled on the floor, poorly trained personnel.)
5	Almost certain	Absence of management controls. If conditions remain unchanged, there is nearly 100 percent certainty that an accident will happen (e.g., broken rung on a ladder, live exposed electrical conductor).

Understanding Severity

- Severity in OHS refers to the extent of harm or damage a workplace hazard can cause to employees, property, or the environment. It helps organizations prioritize risks and implement effective safety measures. High-severity hazards, even if rare, demand immediate attention, while low-severity hazards may require routine monitoring. Assessing severity involves considering injury type, long-term health effects, and operational impact. Understanding severity ensures that resources are allocated efficiently, reducing accidents and promoting a safer workplace culture.
1. Measures potential harm from hazards.
 2. Helps prioritise risk control actions.
 3. Influences safety planning and procedures.
 4. Considers injury type and long-term effects.
 5. Guides resource allocation for prevention.
 6. Supports a proactive workplace safety culture.



Severity (Consequence) Scale

Severity Scale		
Rating Score	Qualitative Element	Definition
0	None	No injury or illness, damage, sickness or other loss is possible.
1	Minor	Minor injury, illness or loss is possible (e.g., light cuts, scratches, insignificant damage to property).
2	Low	Significant injuries or illnesses are possible (e.g., sprains, bruises, lacerations and events needing medical care). Damage to property or process.
3	Medium	Temporary disability is possible (e.g., fractures, finger amputation). Lost workdays due to injury or illness; substantial damage or loss of property or process.
4	High	Permanent disability is possible (e.g., significant loss of movement, loss of limb, sight or hearing)
5	Major	Causing death to one or more people. Loss or damage is such that it could cause serious business disruption (e.g., major fire, explosion or structural damage).
Likelihood (Probability) X Severity (Consequence) = Risk		

Risk Matrix Concept

- A risk matrix is a visual risk ranking tool used in Occupational Health and Safety to assess and prioritise workplace hazards. It combines the likelihood of an incident occurring with the severity of its potential consequences. By plotting these two factors on a grid, organizations can categorize risks as low, medium, high, or extreme. This helps decision-makers identify which hazards require immediate control measures and supports effective, consistent risk management.

Risk assessment matrix

	Severity →				
	Negligible	Minor	Moderate	Significant	Severe
↑ Likelihood					
Very Likely	Low Med	Medium	Med Hi	High	Ext
Likely	Low	Low Med	Medium	Med Hi	High
Possible	Low	Low Med	Medium	Med Hi	Med Hi
Unlikely	Low	Low Med	Low Med	Medium	Med Hi
Very Unlikely	Low	Low	Low Med	Medium	Medium

Risk Matrix Example Likelihood X Severity = Risk Level

5x5 Scoring Matrix

- A 5×5 risk matrix, with five likelihood levels and five severity (impact) levels, supports consistent decision-making by providing a clear, standardized way to evaluate and compare risks across an organization. By assigning each risk a defined likelihood (from rare to almost certain) and a defined severity (from negligible to catastrophic), decision-makers can objectively place risks into comparable categories rather than relying on subjective judgment alone. This consistency helps ensure that similar risks are treated in similar ways, regardless of who is assessing them. The 5×5 matrix is considered one of the best tools to use because it balances simplicity and detail: it is easy to understand and apply, yet detailed enough to distinguish between low, medium, high, and extreme risks. As a result, it improves transparency, prioritization, communication, and accountability in risk management, enabling organizations to focus resources on the most critical risks while maintaining a consistent and defensible decision-making process.



5x5 Scoring Matrix

Risk assessment matrix

Likelihood	Severity				
	Negligible	Minor	Moderate	Significant	Severe
	Very Likely	Low Med	Medium	Med Hi	High
	Likely	Low	Low Med	Medium	Med Hi
	Possible	Low	Low Med	Medium	Med Hi
	Unlikely	Low	Low Med	Medium	Med Hi
	Very Unlikely	Low	Low	Low Med	Medium

Risk Matrix Example

Likelihood X Severity = Risk Level

Risk Scoring

- Risk scoring using a 5×5 risk matrix is a structured method for evaluating and prioritising risks by combining likelihood and severity (impact) into a single, comparable score. In this approach, likelihood is rated on a scale of 1 to 5 (for example, from rare to almost certain), and severity is also rated from 1 to 5 (from negligible to catastrophic). The risk score is calculated by multiplying the likelihood rating by the severity rating, producing a numerical value between 1 and 25. This score represents the overall level of risk and is typically grouped into categories such as low, medium, high, or extreme. Using a 5×5 risk matrix ensures a consistent and transparent evaluation process, helps decision-makers objectively compare risks, and supports clear prioritization of controls and mitigation actions based on the level of risk.

Risk assessment matrix

	Severity →				
	Negligible	Minor	Moderate	Significant	Severe
Likelihood ↑	Very Likely	Low Med	Medium	Med Hi	High
	Likely	Low	Low Med	Medium	Med Hi
	Possible	Low	Low Med	Medium	Med Hi
	Unlikely	Low	Low Med	Low Med	Medium
	Very Unlikely	Low	Low	Low Med	Medium

Risk Matrix Example Likelihood X Severity = Risk Level

Interpreting Risk Rating

- High risks require urgent action, meaning immediate controls or mitigation measures must be implemented to reduce the likelihood or severity of the risk.
- Medium risks require planned controls, where actions are identified, scheduled, and implemented within an agreed timeframe to manage the risk to an acceptable level.
- Low risks require ongoing monitoring, with the risk kept under review to ensure conditions do not change or escalate.

This clear alignment between risk level and response helps organisations prioritise resources effectively and maintain proactive risk management.

Risk assessment matrix

	Severity				
	Negligible	Minor	Moderate	Significant	Severe
Likelihood	Very Likely	Low Med	Medium	Med Hi	High
	Likely	Low	Low Med	Medium	Med Hi
	Possible	Low	Low Med	Medium	Med Hi
	Unlikely	Low	Low Med	Low Med	Medium
	Very Unlikely	Low	Low	Low Med	Medium

Risk Matrix Example Likelihood X Severity = Risk Level

Subjective Judgement (Interpretation)

1. Personal experience shapes risk perception – Individuals who have experienced accidents or near-misses often perceive higher risk than those who have not.
2. Emotional response influences judgment – Fear, anxiety, or confidence can amplify or downplay how dangerous a situation appears.
3. Cultural and social background matters – Different cultures and workplaces normalize different levels of risk.
4. Knowledge and training affect interpretation – Trained assessors may identify hazards others overlook, or view risks as more manageable.
5. Risk tolerance varies between individuals – Some people are naturally risk-averse, while others are more risk-taking.
6. Past success can reduce perceived danger – Repeatedly performing a task without incident may lead to underestimating risk.
7. Situational context changes perception – Time pressure, fatigue, or environmental conditions can alter judgment.
8. Different assessors reach different conclusions – Because risk interpretation is subjective, two assessors may rate the same hazard differently.



Objective Factors

1. Incident and accident records – Past incidents provide factual evidence of hazards and how often they occur.
2. Near-miss reports – These highlight potential risks before harm happens, based on documented events.
3. Industry standards – Established benchmarks help assess acceptable levels of risk consistently.
4. Organisational policies and procedures – Written procedures define safe methods and control measures objectively.
5. Legal requirements and regulations – Laws set minimum safety standards that must be met.
6. Guidance from regulatory bodies – Official guidance (e.g. health and safety authorities) supports evidence-based decisions.
7. Audit and inspection findings – Independent inspections provide unbiased assessments of risk levels



Subjective vs Objective Factors

Subjective Factors

Based on personal judgment

Personal experience

Perception of danger

Attitudes to risk

Emotional responses

Cultural and social influences

Can vary between assessors

Objective Factors

Based on factual evidence

Incident and accident records

Near-miss data and statistics

Standards and codes of practice

Organisational procedures

Legal requirements and regulations

Consistent and verifiable

Key Message: - Subjective = opinion-based and variable - Objective = evidence-based and consistent



Balancing Inputs

1. Balancing objective and subjective inputs in risk perception is essential in occupational health and safety (OHS). Objective data such as incident records, legal requirements, and standards provide a factual foundation for risk assessment and ensure consistency and compliance. However, subjective inputs, including workers' experience and perception of danger, help identify hazards that data alone may overlook. Combining both approaches leads to more accurate risk evaluations, improved worker engagement, and effective control measures that reflect real workplace conditions.



Worked examples

Example 1: Slips on Wet Floors

Hazard: Wet floor in a workplace corridor

Likelihood: 3 – Possible

Severity: 2 – Minor injury (sprain, bruise)

Risk Rating: 6 (Low Medium risk)

Risk assessment matrix

	Severity				
	Negligible	Minor	Moderate	Significant	Severe
Very Likely	Low Med	Medium	Med Hi	High	Very High
Likely	Low	Low Med	Medium	Med Hi	High
Possible	Low	Low Med	Medium	Med Hi	Med Hi
Unlikely	Low	Low Med	Low Med	Medium	Med Hi
Very Unlikely	Low	Low	Low Med	Medium	Medium

Risk Matrix Example Likelihood X Severity = Risk Level

Worked examples

Example 2: Working at Height

Hazard: Falling from a ladder or scaffold

Likelihood: 2 – Unlikely

Severity: 5 – Fatal or major injury

Risk Rating: 10 (Medium High risk)

Risk assessment matrix

	Severity →				
	Negligible	Minor	Moderate	Significant	Severe
Likelihood ↑	Very Likely	Low Med	Medium	Med Hi	High
	Likely	Low	Low Med	Medium	Med Hi
	Possible	Low	Low Med	Medium	Med Hi
	Unlikely	Low	Low Med	Low Med	Medium
	Very Unlikely	Low	Low	Low Med	Medium

Risk Matrix Example Likelihood X Severity = Risk Level

Worked examples

Example 3: Manual Handling

Hazard: Lifting heavy loads incorrectly

Likelihood: 4 – Likely

Severity: 3 – Moderate injury (muscle strain)

Risk Rating: 12 (Medium High risk)

Risk assessment matrix

	Severity				
	Negligible	Minor	Moderate	Significant	Severe
Very Likely	Low Med	Medium	Med Hi	High	Very High
Likely	Low	Low Med	Medium	Med Hi	High
Possible	Low	Low Med	Medium	Med Hi	Med Hi
Unlikely	Low	Low Med	Low Med	Medium	Med Hi
Very Unlikely	Low	Low	Low Med	Medium	Medium

Risk Matrix Example Likelihood X Severity = Risk Level

Risk Control Planning

Risk control planning prioritises hazards by considering their risk rating and potential impact on workers' health and safety. Higher-risk hazards are addressed first to prevent serious injury or harm. The hierarchy of control is used to select the most effective control measures, starting with elimination of the hazard where possible, followed by substitution, engineering controls, administrative controls, and finally personal protective equipment. This structured approach ensures risks are reduced systematically and sustainably. By prioritising planning and applying the hierarchy of control, organisations can manage hazards effectively, comply with legal requirements, and create a safer working environment.



Key Take away

1. Use qualitative tools confidently
2. Understand judgement influences
3. Support safer decisions



Risk Management in Practice

Lecture 6 : Risk Assessment Methodologies Quantitative Approach

Lecturer: Jean Paul Xuereb



**Undergraduate Diploma in
Occupational Health and Safety**

Lecture Aim

Understand how when and how to apply a quantitative Risk Assessment Methodology to manage Risks at the Workplace

This lecture aims to develop learners' understanding of workplace risk by introducing practical quantitative risk assessment techniques used to measure, analyse, and prioritise hazards using numerical data. Students will explore how probability and consequence values are calculated and combined to generate measurable risk levels, and how data-driven decision-making supports safer and more reliable working environments. The session emphasises the importance of accuracy, consistency, and evidence-based reasoning, demonstrating how historical data, statistical analysis, exposure measurements, and modelling influence risk calculations. By the end of the lecture, learners will be able to apply quantitative assessment methods confidently, interpret numerical risk outputs effectively, and support precise risk control planning that aligns with recognised safety practices, regulatory requirements, and organisational standards.



Lecture Overview

1. Introduction to QRA: Overview of quantitative risk assessment principles, purpose, and application within structured workplace safety management systems.
2. Analytical tools: Use of mathematical models, statistical methods, and software tools to quantify likelihood and consequence.
3. Data-driven decisions: Risk control choices informed by measurable evidence, monitoring data, and validated performance indicators.
4. Qualitative vs Quantitative: Comparison of descriptive judgement-based assessments with numerical, data-focused risk evaluation approaches.



Lecture Objective

1. Apply quantitative techniques: Learners will be able to use numerical methods, calculations, and measurable data to assess workplace risks accurately and consistently.
2. Interpret risk data: Learners will develop the ability to analyse, understand, and clearly explain risk values, trends, and numerical assessment outcomes.
3. Use FMEA: Learners will be able to apply Failure Modes and Effects Analysis to identify failures, evaluate risk priority numbers, and prioritise controls.
4. Understand exposure limits: Learners will understand occupational exposure limits, their purpose, and how measured exposures are compared to legal thresholds.



What is a Quantitative Risk Assessment ?

A quantitative risk assessment (QRA) is a structured approach to evaluating workplace risk using numerical data, mathematical models, and statistical analysis. It estimates the probability of hazardous events and the severity of their consequences to produce measurable risk values. QRA supports objective, evidence-based decision-making by relying on historical data, exposure measurements, and predictive modelling. This approach is commonly used in high-risk industries where precision is required to prioritise controls, demonstrate compliance, and justify safety decisions in a transparent and defensible manner.

Key points:

- Uses numerical probability and consequence values
- Relies on data, statistics, and modelling
- Supports objective, evidence-based decisions
- Suitable for complex or high-risk activities



Why we use a Quantitative Risk Assessment Approach ?

1. Reduced subjectivity: Numerical calculations minimise personal judgement, ensuring risk evaluations remain consistent, repeatable, and less influenced by individual perception.
2. Higher accuracy: Quantitative methods use measured data and statistical analysis, producing more precise risk estimates than descriptive assessment approaches.
3. Risk comparison: Standardised numerical outputs allow direct comparison between different hazards, processes, or sites to prioritise controls effectively.
4. Regulatory compliance: Quantitative assessments support compliance by demonstrating risks are evaluated against measurable limits and recognised safety criteria.
5. Improved decision-making: Data-driven risk values provide clear justification for control selection, investment decisions, and long-term safety planning.
6. Monitoring effectiveness: Quantified risk levels enable tracking of control performance over time, supporting continuous improvement and proactive risk management.



Core Components of Risk

Likelihood: The probability that a hazardous event will occur, considering frequency, conditions, controls, and historical incident data.

Consequence: The severity of potential harm or damage if the hazard occurs, including injury, ill health, or loss.

Exposure: The extent, duration, and frequency that workers or systems are subjected to a specific hazard.



Probability Analysis

- Uses historical incident and failure data to estimate the probability of hazardous events occurring.
- Applies statistical (numerical bases) methods to calculate event frequencies and likelihood values objectively.
- Considers equipment reliability, human error rates, and system performance in probability calculations.
- Incorporates exposure frequency and duration to refine probability estimates accurately.
- Utilises fault trees or event trees to model possible failure pathways and outcomes.
- Supports comparison of probabilities across hazards to prioritise risks and control measures effectively.



Risk Calculation – Quantitative RA

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

In quantitative risk assessment, the formula $\text{Risk} = \text{Likelihood} \times \text{Severity}$ is a fundamental tool for evaluating potential hazards. Likelihood represents the probability of an adverse event occurring, while severity measures the potential impact or consequences if the event happens. By multiplying these two factors, organisations can assign a numerical value to each risk, enabling prioritisation and informed decision-making. This approach provides a clear, objective way to compare different risks, identify critical areas requiring mitigation, and allocate resources effectively.



Likelihood Estimations

- Historical data: Past incident records and trend analysis are used to estimate how frequently similar hazardous events occur.
- Failure rates: Equipment reliability data provides numerical failure frequencies to calculate likelihood accurately and consistently.
- Predictive models: Mathematical models simulate system behaviour to estimate likelihood under varying operational conditions.
- Human error probability: Assesses the likelihood of mistakes using task analysis, performance data, and recognised human reliability methods.
- Exposure frequency: Considers how often workers or systems are exposed to hazards to refine likelihood estimations realistically.



Consequence – Severity

- Evaluates potential injury, ill-health, or damage outcomes using measurable impact criteria and predefined severity scales.
- Considers worst credible consequences rather than average outcomes to ensure conservative and protective risk estimates.
- Uses injury statistics, cost data, and loss records to quantify consequence severity accurately.
- Assesses effects on people, assets, environment, and operations to capture full consequence significance.
- Applies standard severity categories aligned with industry benchmarks and regulatory guidance for consistency.
- Supports prioritisation of controls by linking higher consequence values to increased overall risk scores.



Failure Modes and Effects Analysis (FMEA)

- Purpose: FMEA is a systematic method used to identify potential failure modes in a product, process, or system and assess their impact on performance, safety, and reliability.
- Failure Modes: It examines how components or processes can fail, considering all possible ways failures might occur.
- Effects Analysis: For each failure mode, FMEA evaluates the consequences or effects on the overall system or end-user.
- Risk Assessment: Risks are quantified by combining likelihood, severity, and detectability, often resulting in a Risk Priority Number (RPN).
- Prioritisation: High-risk failure modes are prioritised for corrective actions to prevent or mitigate failures.
- Continuous Improvement: FMEA supports ongoing process improvement, helping organizations reduce failures, enhance quality, and increase reliability



(FMEA) Process

1. Form a Safety Team- Gather personnel from safety, operations, engineering, and management to ensure all workplace hazards are identified and addressed.
2. Define Work Scope and Activities- Identify the specific processes, tasks, or areas in the workplace to be analyzed for potential safety risks.
3. Identify Potential Failure Modes- Determine all ways in which safety could be compromised, such as equipment malfunction, human error, chemical exposure, or procedural lapses.
4. Analyze Effects on Health and Safety - Assess the consequences of each failure mode on workers' health, risk of injury, or compliance with safety regulations.
5. Evaluate Risk (Severity, Likelihood, Detection) -Rate the severity of potential injuries, the likelihood of occurrence, and the ability to detect hazards before incidents happen. Calculate the Risk Priority Number (RPN) for prioritization.
6. Prioritize Hazards and Plan Controls-Focus on high-RPN hazards and implement preventive measures such as engineering controls, administrative procedures, training, or personal protective equipment (PPE).Monitor, Review, and Update
7. Continuously review safety measures, update the FMEA as processes or equipment change, and ensure ongoing improvement in workplace safety.



(FMEA) Risk Factors

1. 1. Severity (S) Measures the impact or consequence of a failure or hazard if it occurs. In OHS, severity reflects the potential injury, illness, or fatality to workers. Rated on a scale (commonly 1–10), where 10 represents catastrophic consequences.
2. 2. Occurrence / Likelihood (O) Represents the probability or frequency of the failure/hazard happening. In workplace safety, this could be the chance of an accident occurring due to equipment failure, human error, or unsafe practices. Usually rated on a 1–10 scale, with 10 being very likely to occur frequently.
3. 3. Detection (D) Assesses the ability to detect the failure before it causes harm. Low detection means hazards are hard to notice or predict. Higher detection ratings indicate failures are less likely to be caught before affecting health or safety.
4. 4. Risk Priority Number (RPN) Calculated as **$RPN = \text{Severity} \times \text{Occurrence} \times \text{Detection}$** . Provides a numerical value to prioritise risks, with higher RPNs requiring immediate action.



(FMEA) Risk Matrix

IMPACT		LIKELIHOOD					Risk Rank
		1	2	3	4	5	
		Practically Impossible	Unlikely to Occur	Likely to Happen	Has Occurred	Common or Repeating	
5	Catastrophic	5	10	15	20	25	9-25 High
3	Serious	3	6	9	12	15	5-8 Medium
2	Moderate	2	4	6	8	10	1-4 Low
1	Minor	1	2	3	4	5	

IMPACT RATING GUIDANCE			
	Safety	Environmental	Typical Controls Required to Achieve Impact Level
5	Loss of limbs or death	Requires immediate external response (Fire, Environmental Protection Agency, etc.)	
3	Permanent injury	Requires College response and reporting to outside agency	Administrative controls
2	Professional medical attention required	Requires College response (spill, leak)	One engineering & administrative controls
1	Minor injury	Policy violation	Multiple independent, redundant engineering controls and administrative controls

(FMEA) Risk Assessment Example

Work Activity / Process	Potential Hazard / Failure Mode	Effect on Health & Safety	Severity (S)	Likelihood (O)	Detection (D)	RPN (S×O×D)
Operating machinery	Machine malfunction	Crush injuries, lacerations	9	4	3	108
Handling chemicals	Chemical spill / leak	Skin burns, respiratory issues	8	3	4	96
Manual lifting	Improper lifting technique	Back strain, musculoskeletal injury	7	5	3	105
Working at heights	Fall from ladder / scaffold	Fractures, serious injury	10	2	3	60
Electrical maintenance	Electric shock	Burns, cardiac arrest	10	2	2	40
Confined space work	Oxygen deficiency / toxic gas	Asphyxiation, poisoning	10	2	2	40

Explanation of Columns:

- **Severity (S):** 1–10 scale of how serious the effect is.
- **Occurrence / Likelihood (O):** 1–10 scale of how often the hazard might happen.
- **Detection (D):** 1–10 scale of how likely the hazard will be detected before it causes harm.

Exposure Limits

- Exposure limits in Occupational Health and Safety (OHS) define the maximum acceptable level of exposure to hazardous substances or conditions in the workplace. These limits are set to protect workers from short-term and long-term health effects such as illness, injury, or chronic disease. Exposure limits may apply to chemicals, noise, radiation, or dust and are usually based on an average exposure over a specified time period.

Examples:

1. Permissible exposure limit for carbon monoxide gas

(50 parts per million (ppm) averaged over an 8-hour time-weighted average (TWA))

2. Noise exposure limit value.

(85 decibels (dB[A]) averaged over an 8-hour time-weighted average (TWA))

3. Silica dust exposure limit in construction work.

(50 micrograms of respirable crystalline silica per cubic meter of air ($50 \mu\text{g}/\text{m}^3$), averaged over an 8-hour time-weighted average (TWA))



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Types of Exposure Limits Values

1. Permissible Exposure Limit (PEL): Maximum legal concentration of a hazardous substance workers may be exposed to during a standard work shift.
2. Threshold Limit Value (TLV): Guideline exposure level recommended by experts to prevent adverse health effects in most workers.
3. Time-Weighted Average (TWA): Average exposure allowed over a normal 8-hour workday to control long-term health risks.
4. Short-Term Exposure Limit (STEL): Maximum exposure permitted for a short duration, usually 15 minutes, without causing immediate harm.
5. Ceiling Limit (C): Concentration that must never be exceeded at any time during workplace exposure.



Where to obtain Exposure Limits Values?

Exposure limit values in Occupational Health and Safety can be obtained from several authoritative sources. Government regulatory agencies such as OSHA and the UK Health and Safety Executive publish legally enforceable exposure limits for hazardous substances. International organizations like the World Health Organization (WHO) and the International Labour Organization (ILO) also provide guidance values. Professional bodies such as the American Conference of Governmental Industrial Hygienists (ACGIH) publish Threshold Limit Values (TLVs). In addition, material safety data sheets (SDS) supplied by manufacturers contain exposure limits specific to chemicals. These sources help employers maintain safe workplaces.



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Dose Response Data

Dose–response data in Occupational Health and Safety (OHS) describes the relationship between the amount of exposure to a hazardous agent and the severity or likelihood of adverse health effects. This data helps determine safe exposure levels by identifying the dose at which no harmful effects occur and the dose at which health risks increase. Dose–response relationships are developed through epidemiological studies, laboratory experiments, and workplace monitoring. They are essential for setting exposure limits such as Permissible Exposure Limits (PEL) and Threshold Limit Values (TLV). By understanding dose–response data, OHS professionals can assess risk, implement effective control measures, and protect workers from both acute and chronic occupational illnesses.



Working with Data

Collect accurate data: Gather reliable incident records and exposure monitoring results from all relevant work activities.

Analyse incident trends: Identify recurring hazards, high-risk tasks, and patterns indicating underlying safety management weaknesses.

Compare exposure data: Evaluate measured exposures against OELs or ELVs to determine compliance and risk levels.

Identify correlations: Link incident trends with exposure levels to understand cause–effect relationships in workplace hazards.

Prioritise controls: Use data trends to focus resources on areas with highest incident rates and exposures.

Review and update: Regularly reassess data to track improvement and adjust OHS control measures accordingly.



Interpreting Trends

1. Interpreting trends in OHS risks: Analysing OHS data over time identifies whether incidents are increasing, decreasing, or stable. Trends help prioritise hazards, allocate resources, and implement preventive strategies for long-term workplace safety improvement.
2. Patterns in OHS risks: Patterns reveal recurring causes, locations, or times of incidents. Recognizing these helps predict potential hazards, design targeted interventions, and enhance safety culture by addressing systemic issues efficiently.
3. Variation in OHS risks: Variation highlights differences in incident frequency or severity across teams, processes, or shifts. Understanding normal fluctuations distinguishes manageable risks from areas needing urgent safety improvements.
4. Abnormal data in OHS risks: Abnormal data points indicate unusual incidents or outliers, possibly signalling hidden hazards, reporting errors, or emerging risks. Investigating these anomalies prevents recurrence and strengthens overall safety management.



From Data to Decisions

1. **Data Collection-** Gather quantitative data such as historical incident frequencies, failure rates, exposure levels, asset values, and vulnerability data from databases, sensors, audits, and expert sources.
2. **Data Validation & Preparation-** Clean, normalize, and validate the data to ensure accuracy and consistency. Address missing values, uncertainties, and assumptions, and document data limitations.
3. **Risk Identification & Scenario Definition-** Define risk scenarios by linking hazards, initiating events, and potential consequences. Quantify parameters such as likelihood, severity, and exposure for each scenario.
4. **Risk Quantification & Modeling -**Apply quantitative methods to calculate risk metrics such as expected loss, probability of failure, or annualised risk.
5. **Risk Evaluation & Comparison-** Compare quantified risks against risk criteria, thresholds, or tolerability limits. Rank risks to identify high-priority scenarios and evaluate sensitivity and uncertainty.
6. **Decision-Making & Risk Treatment -** Use the results to support decisions such as risk acceptance, mitigation, transfer, or avoidance. Select and justify control measures based on cost–benefit analysis and residual risk.



From Data to Decisions

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Accuracy and Objectivity

Accuracy and objectivity are fundamental to credible analysis and sound decision-making. Accuracy ensures that information, data, and calculations correctly represent reality, minimizing errors that could lead to flawed conclusions or ineffective actions. Objectivity complements accuracy by requiring neutrality, where judgments are based on evidence rather than personal bias, assumptions, or external pressures. Together, they enhance the reliability and transparency of assessments, particularly in quantitative risk management processes where results directly influence risk evaluation and policy choices. Maintaining accuracy and objectivity builds trust among stakeholders, supports consistent outcomes, and strengthens the overall quality and defensibility of decisions across scientific, technical, and professional contexts.



Qualitative vs Quantitative

Qualitative risk assessment focuses on descriptive analysis using expert judgment, experience, and relative ranking to evaluate risks. It categorizes risks using scales such as low, medium, or high, making it easy to understand and communicate. This approach is useful when data is limited, time is constrained, or risks are complex and difficult to measure numerically. However, qualitative assessments may be subjective and less precise, which can affect consistency and comparability of results.

Quantitative risk assessment uses numerical data and statistical models to estimate the probability and impact of risks in measurable terms, such as frequencies or monetary loss. It provides objective, detailed results that support cost–benefit analysis and informed decision-making. This approach is especially valuable for high-stakes or complex systems. However, it requires reliable data, technical expertise, and more resources, and results may be sensitive to data quality and assumptions.



Qualitative vs Quantitative

Aspect	Qualitative Risk Assessment	Quantitative Risk Assessment
Nature of Analysis	Descriptive and judgment-based	Numerical and data-driven
Data Requirements	Limited or subjective data	Extensive, reliable data
Risk Expression	Categories (low, medium, high)	Numerical values (probability, loss)
Objectivity	More subjective	More objective
Precision	Lower precision	Higher precision
Complexity	Simple to moderate	More complex
Time & Cost	Faster and less costly	Time-consuming and costly
Tools Used	Risk matrices, expert judgment	Statistical models, simulations
Uncertainty Handling	Implicit, less formal	Explicit, probabilistic
Best Use Case	Early-stage or low-risk decisions	High-risk or critical decisions



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