



# **Health, Safety and Environment (HSE) in Industrial Installations**

**Target: 2nd Year Engineering  
Students**

**Instructor: Dr. GRINE Wassila**

A photograph of two industrial workers in a factory setting. Both are wearing yellow hard hats, safety glasses, and white face masks. They are wearing blue long-sleeved shirts and high-visibility orange safety vests with reflective silver stripes. The worker on the left is holding a smartphone, and the worker on the right is holding a walkie-talkie to his mouth. The background shows a blurred industrial environment with large windows and structural elements.

# Chapter 1: Risk Assessment and Accident Analysis

Description: Introduction to Safety Systems for

Industrial Engineering

# Five-Session Roadmap

- **Session 1:** Introduction to HSE & Fundamental Concepts
- **Session 2:** Prevention Stakeholders & Safety Performance Indicators
- **Session 3:** Risk Analysis Methodology
- **Session 4:** Root Cause Analysis Methods
- **Session 5:** Risk Families & Integrated Case Study



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# SESSION 4: Root Cause Analysis Methods

Date: 12/11/2025

14H50-16H20



# Introduction to Accident Analysis

## Why Analyze Accidents?

- Understand why accidents happen, not who is responsible
- Prevent recurrence by addressing root causes
- Improve safety systems and procedures

### Accident vs. Incident:

- ❑ **Accident:** Event resulting in injury, illness, or damage
- ❑ **Incident:** Near-miss or close call with potential for harm



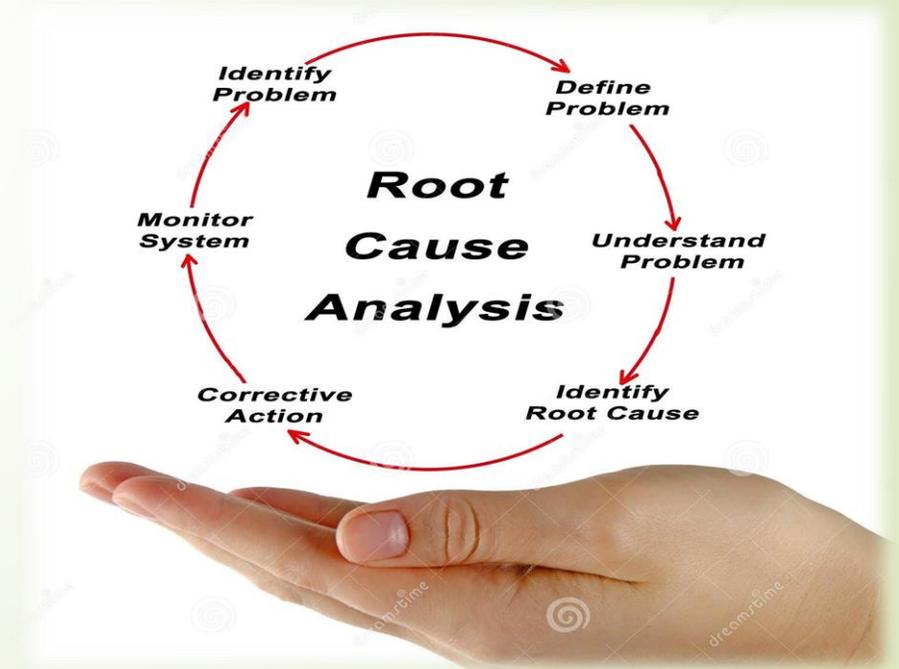
# What is Root Cause Analysis?

## Definition:

"A structured method used to analyze serious adverse events to identify underlying root causes and develop corrective actions"

## Key Principles:

- ▶ Systematic and structured approach
- ▶ Focus on systems and processes, not individuals
- ▶ Dig deep beyond immediate causes
- ▶ Aim for permanent solutions



# Common RCA Methods

## 1. 5 Whys Technique

- Simple questioning method to drill down to root cause
- Repeatedly ask "Why?" until reaching fundamental cause

## 2. Cause and Effect Diagram (Fishbone/Ishikawa)

- Visual tool to identify and organize potential causes
- Categories: People, Methods, Materials, Machines, Environment, Measurement

## 3. Fault Tree Analysis

- Deductive, top-down approach
- Uses Boolean logic to analyze system failures



# The 5 Whys Technique - Demonstration

- ❑ Scenario: Worker slips and falls in workshop
- **Why did the worker fall?** → Slipped on oily surface
- **Why was there oil on the floor?** → Machine leaking oil
- **Why was the machine leaking?** → Worn seal not replaced
- **Why wasn't the seal replaced?** → No preventive maintenance schedule
- **Why no maintenance schedule?** → Lack of maintenance system and resources
- ❑ **Root Cause: Inadequate maintenance management system**



# Cause and Effect Diagram - Structure

## Fishbone Diagram Components: ← What is this diagram?

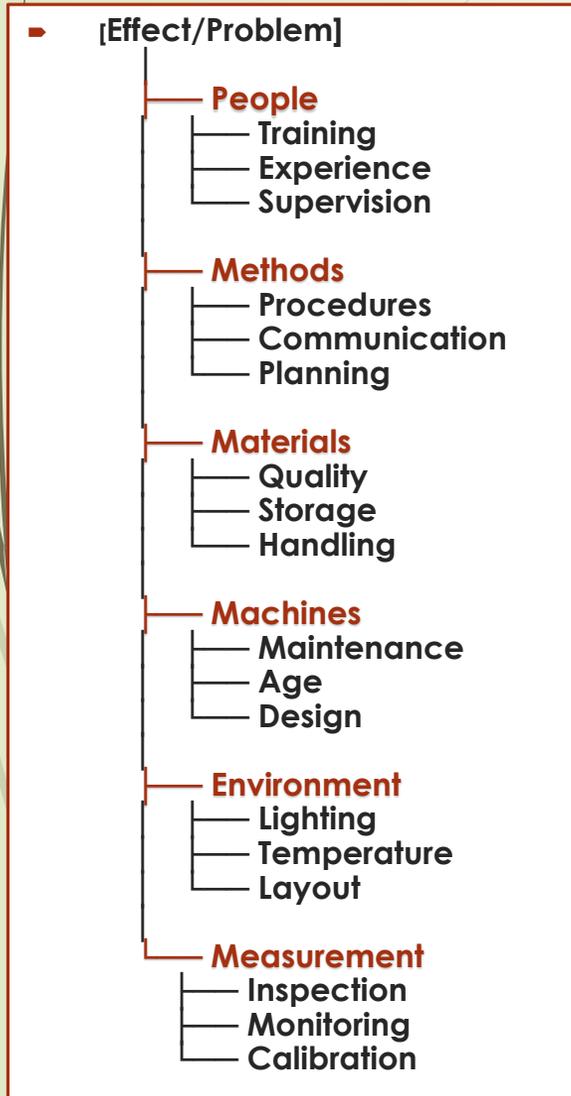
It is a visual analysis tool resembling a **fishbone**, used to identify all potential causes of a specific problem. (**Cause-and-Effect Diagram**)

### Main Components:

- **Fish head:** The main problem/effect
- **Fish bones:** Major cause categories (6Ms)
- **Small bones:** Specific causes within each category

### How to use this diagram?

- ✓ Define the problem clearly in the fish head
- ✓ Gather a work team from all specialties
- ✓ Suggest causes under each category
- ✓ Analyze the causes and identify the most impactful ones
- ✓ Apply appropriate solutions

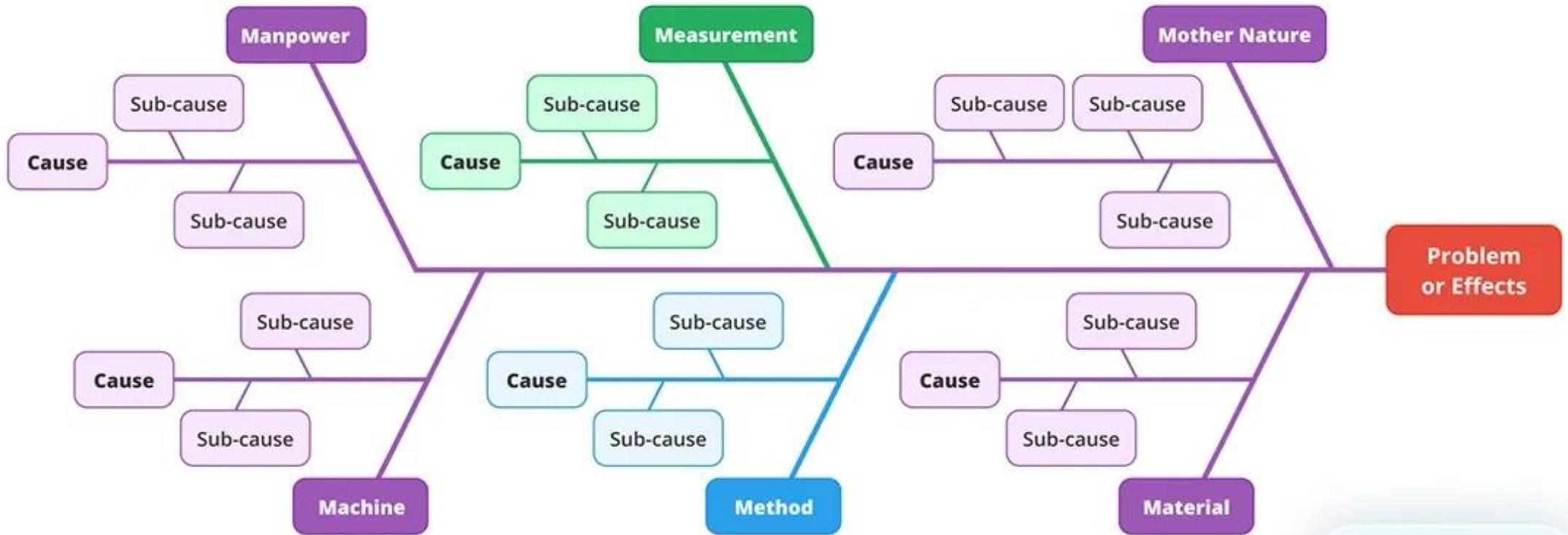


# Fishbone Diagram



Add +

View



# Practical Application Example:

## Problem: "Repeated slipping incidents in the workshop"

- Application on the diagram:

### [Repeated slipping incidents]

#### People

- Not wearing safety shoes
- Negligence and lack of attention

#### Methods

- Absence of cleaning procedures
- Poor organization of cleaning schedules

#### Materials

- Use of slippery cleaning materials
- Leakage of oils and materials

#### Machines

- Oil leakage from equipment
- Absence of spill containers

#### Environment

- Smooth flooring
- Poor lighting

#### Measurement

- Lack of floor cleanliness monitoring
- Failure to calibrate detection devices



# Interactive Activity - 5 Whys Practice

➤ **Scenario: "A chemical spill occurred during transfer operations, exposing two workers to hazardous vapors."**

➤ **Group Task:** Apply the 5 Whys technique to identify the root cause.

➤ **Time:** 15 minutes group work + 10 minutes sharing

➤ **Guiding Questions:**

➤ **Why did the spill occur?**

➤ **Why weren't containment measures effective?**

➤ **Why were workers exposed?**

➤ **Why weren't controls in place?**

## ➤ Application of the 5 Whys Technique

1. **Why did the spill occur?**

❑ Answer: Transfer hose burst due to wear and tear and not being replaced on time.

2. **Why weren't containment measures effective?**

❑ Answer: Containment tray was full and not emptied, with no clear spill response procedures.

3. **Why were workers exposed to hazardous vapors?**

❑ Answer: They weren't wearing appropriate respiratory protection and weren't trained on vapor hazards.

4. **Why weren't safety controls in place?**

❑ Answer: No updated risk assessment and reliance on informal procedures.

5. **Why did these system gaps persist?**

❑ Answer: Root Cause: Lack of integrated safety management system and insufficient safety resource allocation.

➤ Visible Problem: **Chemical spill**

➤ Root Cause: **Absence of safety culture and investment in prevention systems**

➤ Fundamental Solution: **Develop comprehensive safety management system with adequate resource allocation**

# RCA Case Study - Industrial Accident

- Scenario: "**Maintenance worker severely injured while repairing conveyor system**"

## Initial Facts:

- Worker bypassed safety interlock
- Machine started unexpectedly
- No lockout/tagout procedure followed
- Inadequate supervision

## Investigation Findings:

- Multiple system failures identified
- Organizational and cultural issues
- Training deficiencies
- Equipment design flaws

# Group Activity - RCA Diagram

- ▶ **Task:** Create a Cause and Effect Diagram for the conveyor accident
- ▶ **Categories to Consider:**
- ▶ **People:** Training, competence, supervision
- ▶ **Methods:** Procedures, work permits, communication
- ▶ **Machines:** Design, maintenance, safety features
- ▶ **Environment:** Lighting, noise, workspace
- ▶ **Management:** Policies, resources, safety culture
- ▶ Time: 15 minutes group work + 5 minutes presentations



# From Analysis to Action

## Turning Findings into Prevention:

### 1. Immediate Actions:

- Address urgent safety issues
- Temporary controls and warnings

### 2. Corrective Actions:

- Fix identified root causes
- Update procedures and training

### 3. Preventive Actions:

- Systemic improvements
- Continuous monitoring
- Cultural changes



# Effective Corrective Actions

## SMART Criteria for Actions:

**Specific** - Clear and precise

**Measurable** - Quantifiable results

**Achievable** - Realistic and feasible

**Relevant** - Addresses root cause

**Time-bound** - Clear deadline

### Examples:

✓ "Train all maintenance staff on updated LOTO procedures by end of month"

✗ "Improve safety training" (too vague)



# RCA Documentation

## ➤ Essential Report Elements:

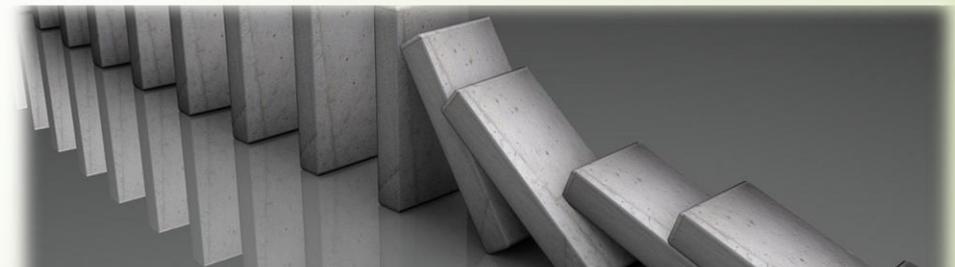
1. Executive summary
2. Incident description and timeline
3. Investigation methodology
4. Causal analysis findings
5. Recommended actions
6. Responsibility and timelines
7. Follow-up and verification plan



# Common RCA Pitfalls

## ➤ Mistakes to Avoid:

- Stopping at symptoms, not root causes
- Blaming individuals instead of systems
- Rushing to solutions without proper analysis
- Failing to verify root causes with evidence
- Not involving frontline workers
- Ignoring organizational and cultural factors



**✘ CAUTION**

**CONTROL**



# Success Factors in RCA

## Key Elements for Effective RCA:

- ▶ Management commitment and support
- ▶ Multidisciplinary investigation team
- ▶ Open and honest reporting culture
- ▶ Adequate time and resources
- ▶ Follow-through on recommendations
- ▶ Sharing lessons learned



# Session 4 Summary

## Key Takeaways:

**RCA Purpose:** Prevent recurrence by addressing root causes

**Main Methods:** 5 Whys, Cause and Effect Diagrams, Fault Tree Analysis

**Process:** Systematic investigation → Analysis → Action → Verification

**Mindset:** Focus on systems improvement, not individual blame

«Find Root Causes Today — Prevent Accidents Tomorrow»

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*Thank you all for your attention*

