

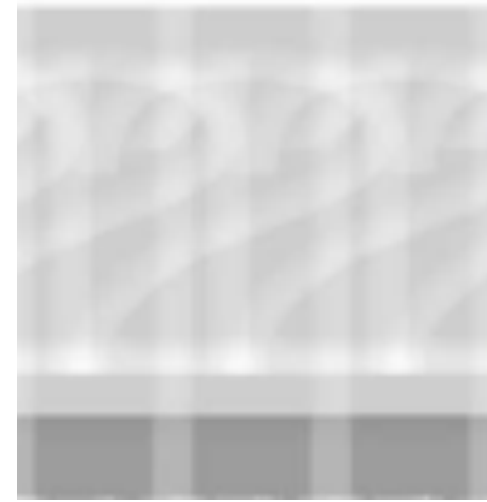
Health and Safety Essentials

Lecture 16 – Accident Investigation Techniques

George Steve Darmanin

MSc.OHSEM CMIOSH

Date: 17th February 2025



Undergraduate Diploma in
Occupational Health and Safety

Recap last week's topic

Kahoot Quiz:

https://play.kahoot.it/v2/*?quizId=0ef30be5-bf2b-4921-b824-5d392017a97f



Objectives of the Lecture

- ✓ Define accident investigation principles and their role in preventing future incidents.
- ✓ Explore causation theories and their real-world applications.
- ✓ Examine regulatory requirements for accident reporting and investigations.
- ✓ Learn structured accident investigation techniques (evidence collection, witness interviews, root cause analysis).
- ✓ Develop professional accident investigation reports using best practices.



"They're funny things,
Accidents. You never have
them till you're having
them"

Eeyore (from A. A. Milne's
Winnie The Pooh)



slido

Please download and install the Slido app on all computers you use



**How familiar are you with
accident investigation principles?**

① Start presenting to display the poll results on this slide.

Why Investigate Accidents?

● Key Investigation Drivers

1. Legal Compliance – Ensuring adherence to

■ L.N. 52 of 1986 Workplaces (Health Safety and Welfare) Regulations - Part V mentions Notification rather than Investigation; Cap. 646 focuses on OHSA investigations.

■ EU (89/391/EEC) and

■ UK (RIDDOR 2013, HSWA 1974).

■ Subsidiary Regulations: Exposure To Carcinogens, Physical Agents...

1. Preventing Recurrence – Understanding what went wrong to avoid repeat incidents.

2. Building a Safety Culture – Learning from incidents without attributing blame.

3. Financial & Reputational Risks – Avoiding fines, compensation claims, and loss of business trust.



Employer's Role in Accident Investigations

-  Key Points:

1. Employers must report workplace injuries as per Cap. 646 - L.N. 52 of 1986
2. Formal investigations are not explicitly required but may be necessary to determine causes.
3. Employers must document corrective measures, implying a fact-finding process is expected.
4. OHSA Malta can intervene and investigate serious cases.



Discussion Point



- *Would a legal obligation for full investigations improve safety in Malta?*
- *Should Legislation require detailed employer-led investigations for all major incidents? (Context: Efforts to Report & Investigate Near Miss Incidents)*

Case Study:

- A workplace **scaffolding collapse** that resulted in multiple injuries.
- Should the employer **only report the incident**, or should a **full investigation** be required?



Who Should Conduct an Investigation?

- **Maltese Legislation and EU Directive 89/391/EEC (Framework Directive)** does not explicitly require a **team-based** approach.
- Instead, it places the duty on **the employer to analyse workplace incidents** and take corrective action and communicate with workers' reps.
- In some **EU member states (e.g., Germany, France, Sweden)**, national laws or industry regulations may specify that:
 - A **competent person** (e.g., a health & safety officer) must lead the investigation.
 - **Workers' representatives** must be consulted if a serious workplace accident occurs.
 - **OHSA/Labour inspectors** may conduct their own investigations.



The Investigation Team – Selecting the Right People

- **Ideal Team Composition:**

- OHS Manager/Officer
- Safety representatives.
- Line manager/supervisor.
- Worksite personnel.
- Experts with relevant knowledge (e.g., engineers for technical failures).



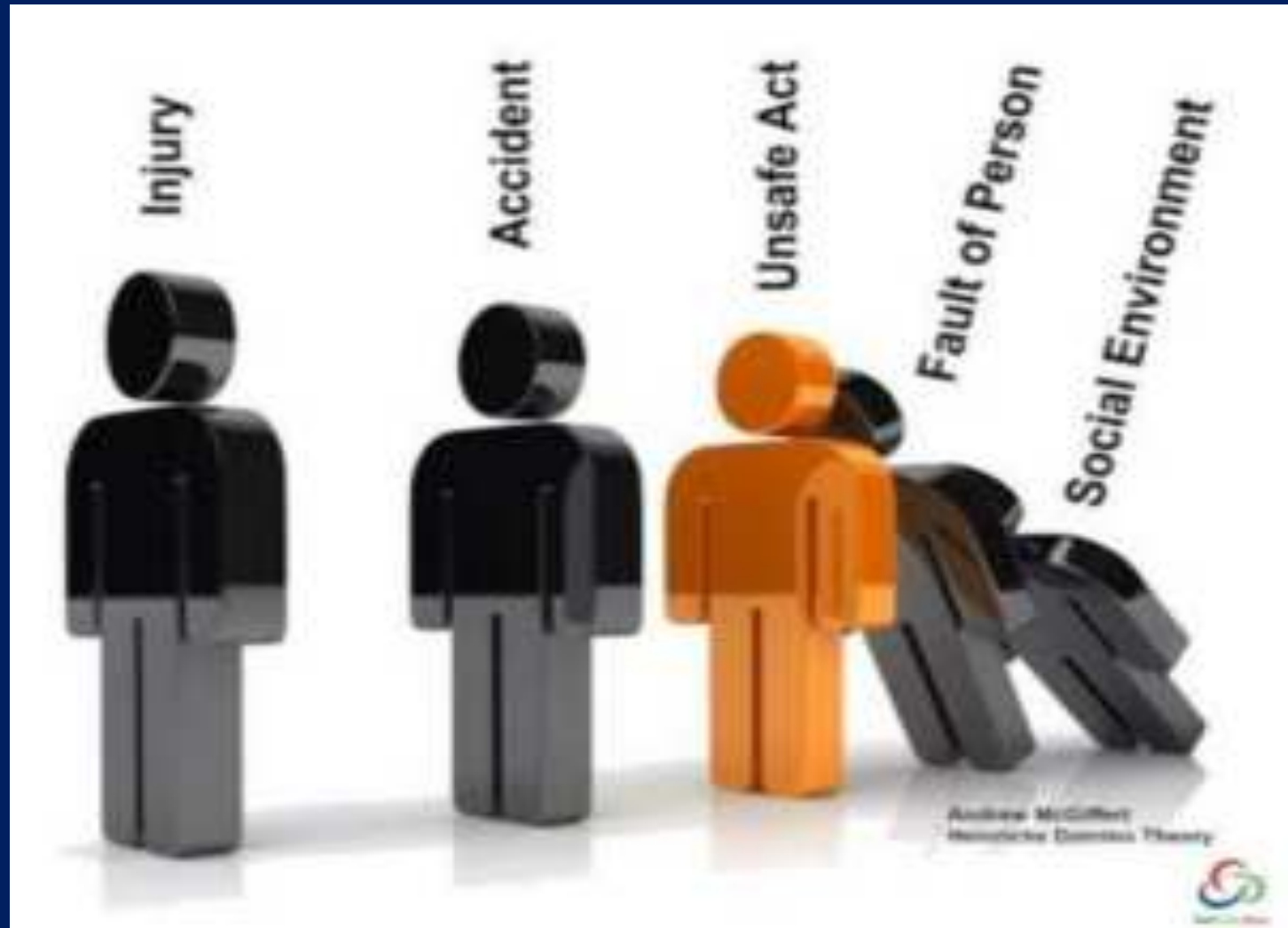
Theories of Accident Causation & Investigation Focus

Causation Models

- **Heinrich's Domino Theory** – Chain of failures.
- **Reason's Swiss Cheese Model** – Latent system failures.
- **Bird's Triangle** – Precursor incidents.
- **Ferrell's Human Factor Model** – human error – caused by overload / incompatibility / improper activities.
- **Petersen's Model** – Adapts Ferrell's and Heinrich's...
- **5M Model** – Man, Machine, Medium, Mission, and Management.

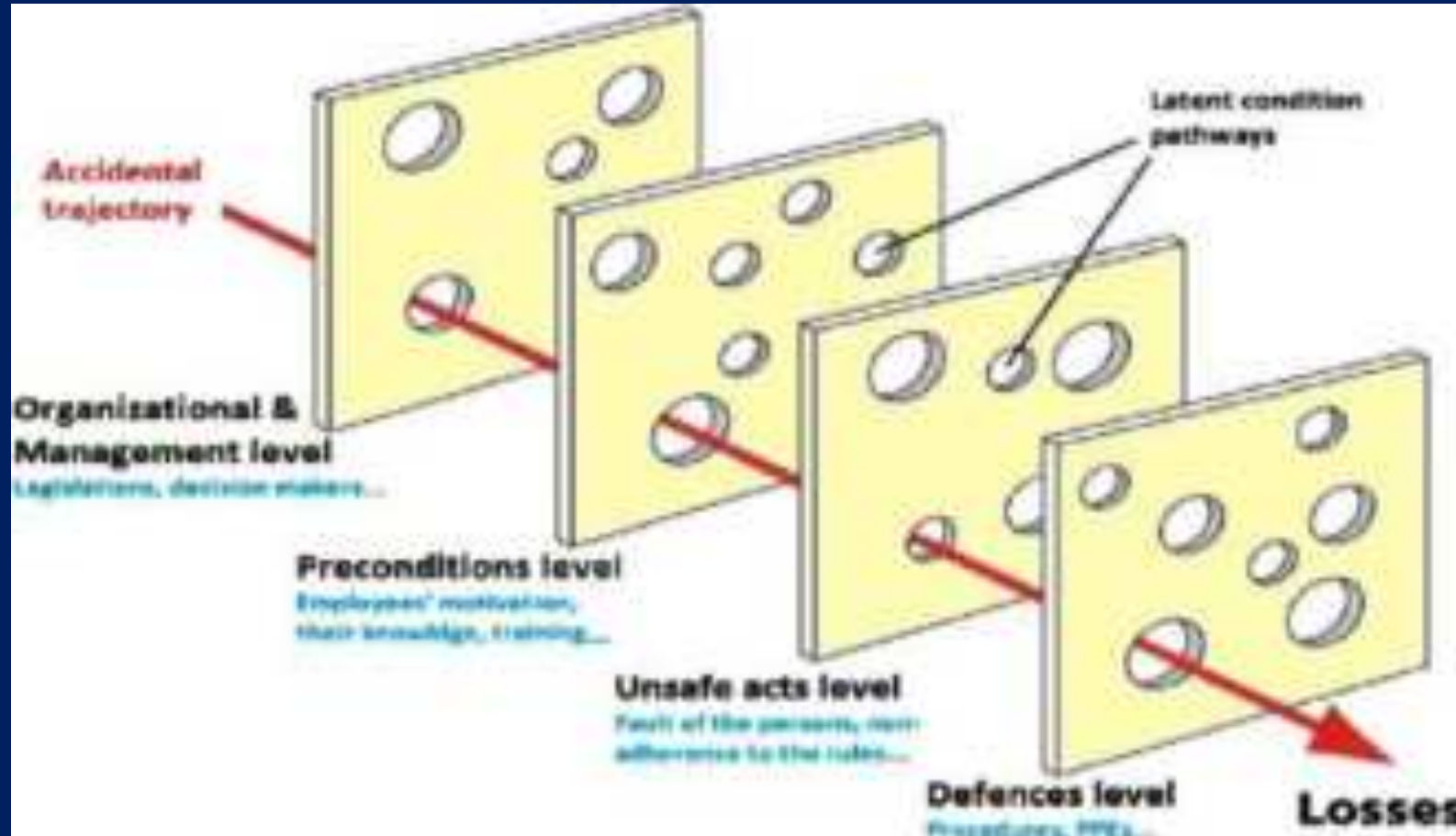


Heinrich's Domino Theory

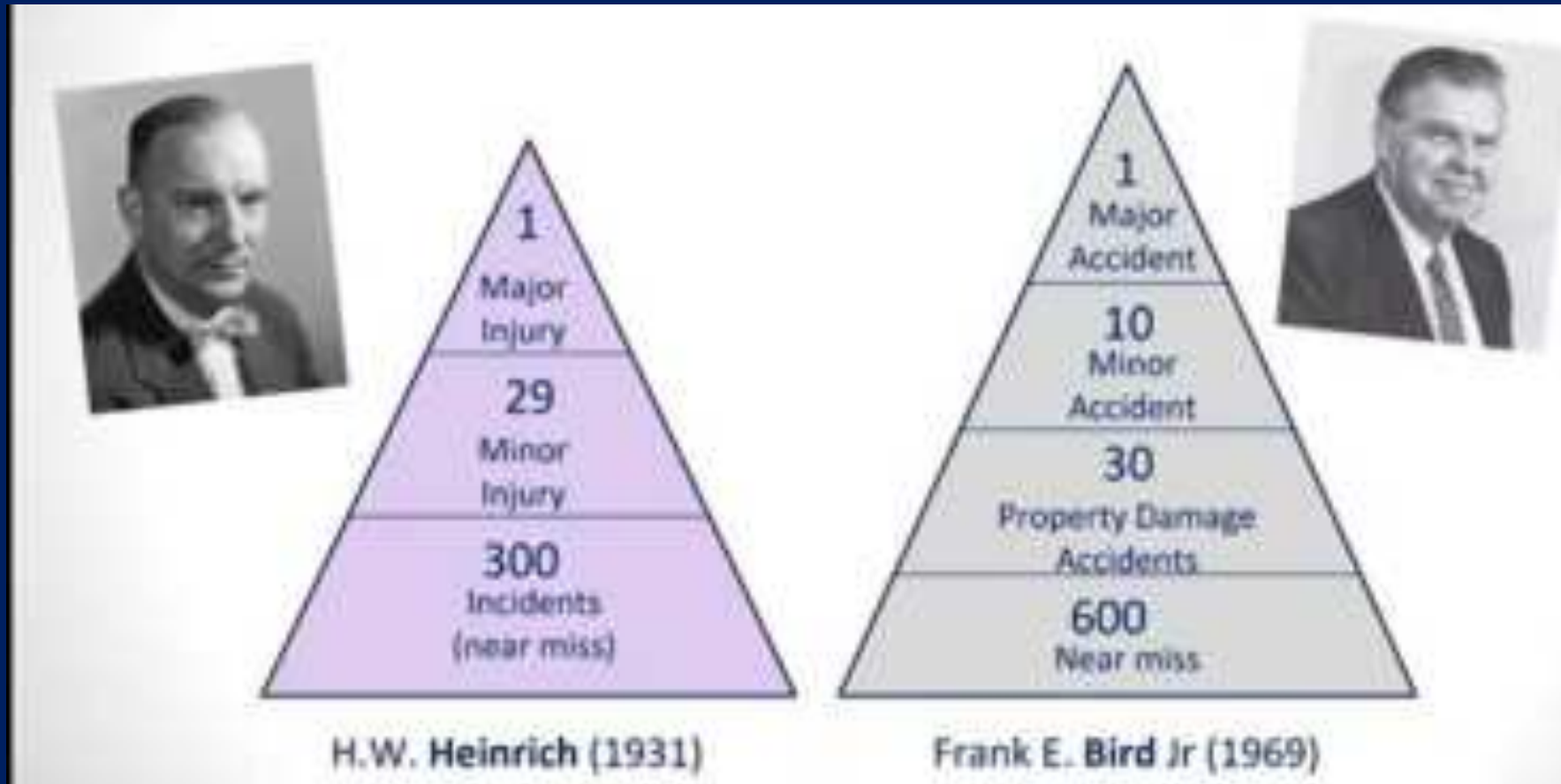


(Heinrich, 1931)

Reason's Swiss Cheese Model



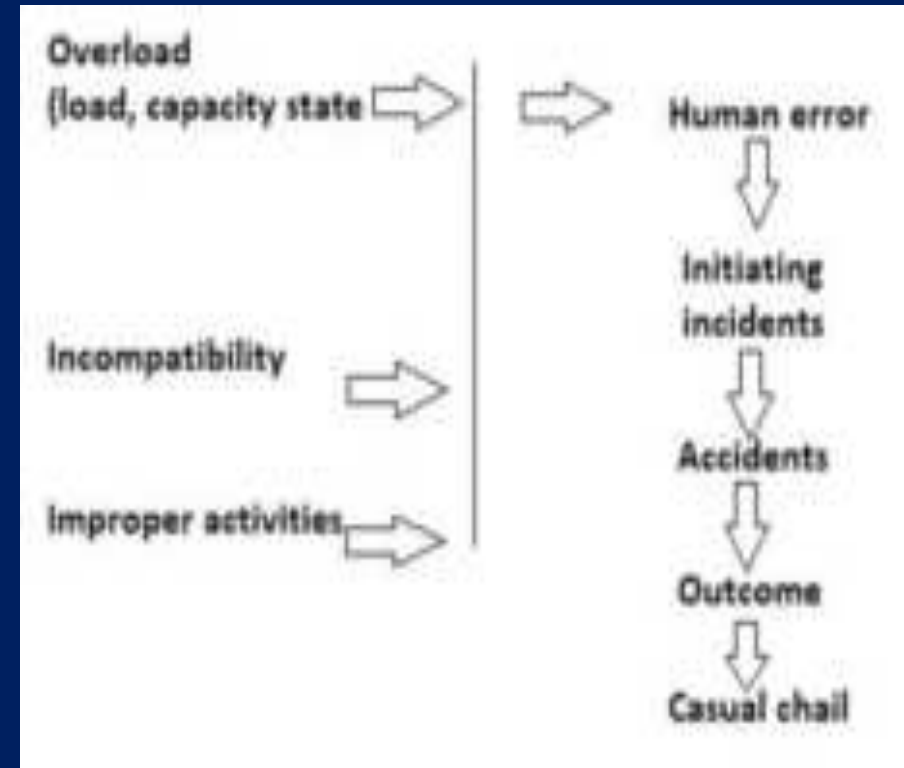
Heinrich's & Bird's Triangles



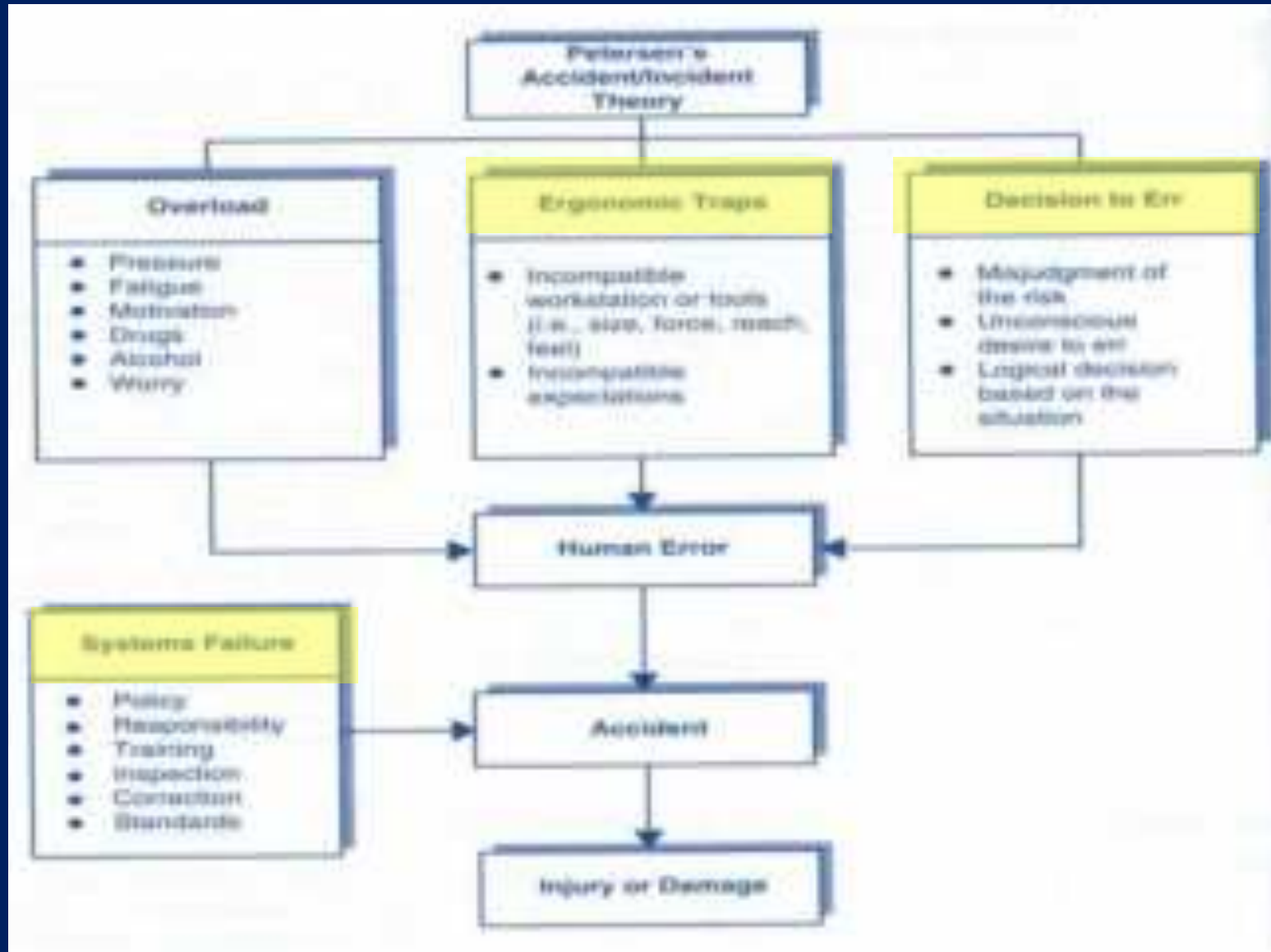
Ferrell's Human Factors Theory

This theory identifies three primary causes of accidents:

- **Overload** – When the demands on a worker exceed their capacity to respond effectively.
- **Incompatibility** – A mismatch between human abilities and work conditions.
- **Improper Activities** – Errors made due to lack of knowledge or deliberate risk-taking.



Petersen's Accident–Incident Causation Theory



slido

Please download and install the Slido app on all computers you use



What does Reason's Swiss Cheese Model illustrate?

① Start presenting to display the poll results on this slide.

slido

Please download and install the Slido app on all computers you use



What does 'overload' refer to in Ferrell's theory?

① Start presenting to display the poll results on this slide.

slido

Please download and install the Slido app on all computers you use



What is a key component of Petersen's theory?

① Start presenting to display the poll results on this slide.

Break



5-M Model Approach to Accident Investigation

- **What is the 5-M Model?**
 - A systematic method for analysing accident causes.
 - **Primarily used in aviation**, but also applied in maritime, transport, industrial safety, and healthcare.
- **The Five Key Areas:**
 - **Man** – Human factors such as training, qualifications, and mental/physical state.
 - **Machine** – Equipment design, maintenance, and reliability.
 - **Medium** – Environmental conditions, including weather and infrastructure.
 - **Mission** – The complexity and nature of the operation.
 - **Management** – Organisational policies, safety culture, and decision-m



6M Model

- The **6M Model** builds on 5M by adding **one more category**:
+ Measurement (Metrics/Data/Control Systems) – Issues related to incorrect data, miscalculations, or faulty sensors.

Why Add "Measurement"?

- Many errors in modern workplaces come from data errors (e.g., incorrect risk assessments, equipment calibration errors).
- Common in industries relying on data-driven decisions (e.g., aviation, pharmaceuticals, finance, IT).



Case Study – Singapore Airlines Flight 006

- <https://www.youtube.com/watch?v=ubjLhBaLD1Y>
- **Incident Summary:**
 - On 31 October 2000, SQ006 attempted takeoff on a closed runway (05R) at Taipei Airport in poor visibility.
 - The aircraft collided with construction equipment, resulting in 83 fatalities.
- **Findings Based on the 5-M Model:**
 - **Man:** Pilots failed to verify the taxi route and use the Para-Visual Display.
 - **Machine:** No mechanical issues; aircraft was airworthy.
 - **Medium:** Poor visibility due to Typhoon Xangsane; inadequate airfield lighting and signage.
 - **Mission:** Urgency to depart before worsening weather may have influenced errors.
 - **Management:** Lack of proper ground radar; non-compliance with ICAO safety standards.

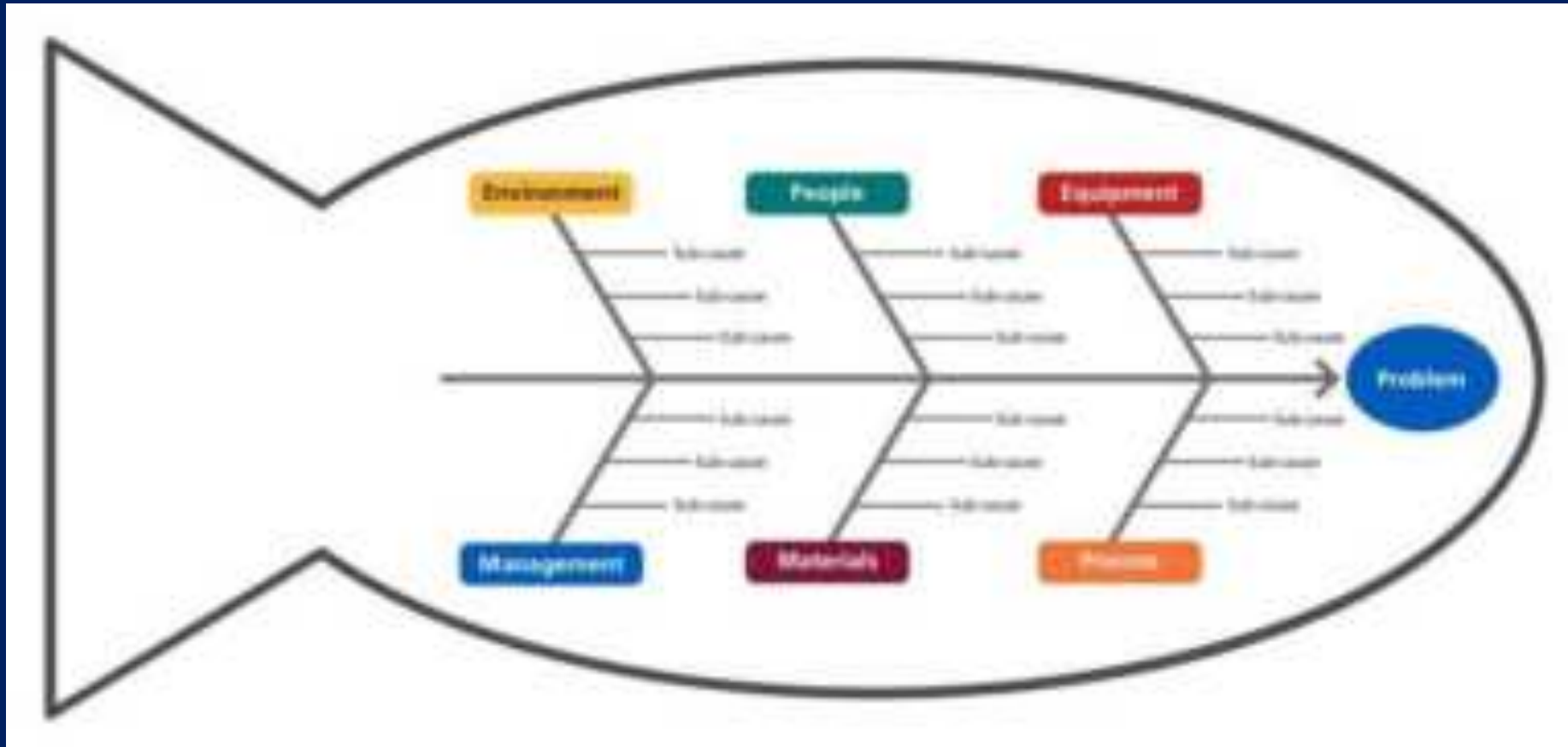


Fishbone Analysis




- 📌 **Developed by Professor Kaoru Ishikawa in the 1960s.**
 - Also known as **Cause-and-Effect Diagram** due to its fishbone-like structure.
 - Combines brainstorming with mind mapping for structured root cause analysis.
- 📌 **Uses of Fishbone Analysis**
 - ✓ Discover the root cause of a problem.
 - ✓ Uncover bottlenecks in a process.
 - ✓ Identify why a process is not working effectively.
 - ✓ Often adapted and integrated with 6M
- 📌 **Team-Based Approach**
 - Fishbone Analysis should always be a team effort.
 - A team must consist of individuals with **specialist knowledge and open minds.**



Fishbone Diagram Example & Application



Key Components of Fishbone

- 1 Problem (Head of the Fish) – Clearly defined issue to investigate.
 - 2 Main Causes (Fish Bones) – The major categories influencing the problem.
 - 3 Sub-Causes (Small Bones) – Specific factors contributing to each category.
-  **Standard 6M Categories for Analysis:**
 - ✓ **Man (People)** – Training, skills, human error, workload.
 - ✓ **Machine (Equipment)** – Faulty tools, technology issues, maintenance problems.
 - ✓ **Method (Process)** – Inefficient workflows, unclear instructions, missing procedures.
 - ✓ **Material** – Poor quality raw materials, incorrect supplies.
 - ✓ **Milieu (Environment)** – Workplace conditions (noise, lighting, temperature).
 - ✓ **Management (Leadership/Policies)** – Poor supervision, lack of enforcement.
 -  **Alternative Categories**
 - Depending on the problem, categories can be adjusted to include:
 - Information systems
 - Work organisation
 - Competitor influence
 -  **Key Takeaway:**
 - All branches lead to the problem at the head, helping teams see how different elements contribute to failure.



Step-by-Step Accident Investigation Process

-  **Systematic Procedures**

- 1. Immediate Response & Site Preservation**

1. Act quickly before evidence is disturbed.
2. Photograph and sketch the scene.

- 2. Evidence Collection**

1. Secure tools, equipment, chemical samples.
2. Interview witnesses separately.

- 3. Analyse Past Incidents**

1. Check for similar near-misses.

- 4. Identify Causes Using Systematic Approaches**

1. Five Whys, Fishbone, Bowtie Analysis.

-  **Best Practice: "Look for causes, not blame."**

- Systems fail for multiple reasons. Blaming individuals **hinders future safety improvements.**









Evidence Collection & Interviewing Witnesses

Best Practices:

- Secure evidence immediately.
- Check if anything has been moved.
- Document site conditions (lighting, weather, noise levels).
- Interview separately to prevent influencing statements.

Investigator's Checklist (5 Ws + How):

-  Who was involved? Who saw it? Who supervised the task?
-  What was being done? What tools were used? What went wrong?
-  When did it happen? When was it last checked?
-  Where did it happen?
-  Why (x5) did this occur? Why were safety measures ineffective?...
-  How could this have been avoided?



Root Cause Analysis Techniques

Key Methods for Root Cause Analysis:

1. **Swiss Cheese Model (James Reason)** – Identifying multiple layers of failure.
2. **Peterson's Model of Accident Causation** – Focusing on safety management failures.
3. **Five Whys** – Systematic questioning to uncover root causes.



Writing an Effective Investigation Report

Report Structure

1. **Introduction:** Overview of incident.
2. **Incident Description:** Facts only.
3. **Findings:** Root cause analysis.
4. **Recommendations:** Preventive measures.

Best Practices:

- Be factual, clear, and neutral.
- Use photographs, logs, witness statements.
- Avoid assumptions – stick to evidence-based conclusions.



Case Study – Fall from Height (Construction)

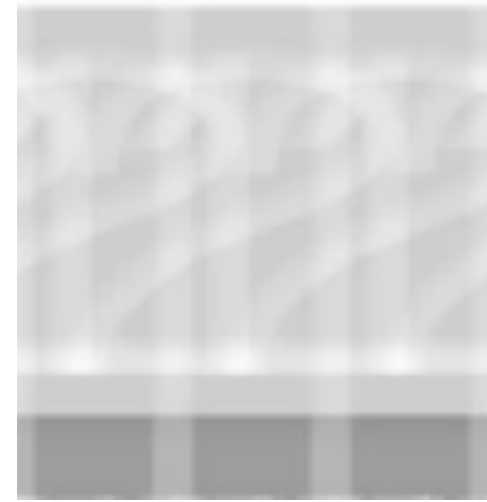
📁 Scenario:

- A worker falls 3m from scaffolding, breaking a leg.
- No guardrails
- Witnesses were unskilled workers. No supervision on site.

📌 Activity Groups to Investigate:

1. Immediate Cause
2. Underlying Cause
3. Root Cause
4. If you have time....consider creating a Fishbone Diagram





**Undergraduate Diploma in
Occupational Health and Safety**