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Mastering the Art of Effective Investigation Techniques

Thursday, 7 December 2023 | Technical Topic Webinar

Presented by

Dr. Asieh Soltani
EIT Lecturer

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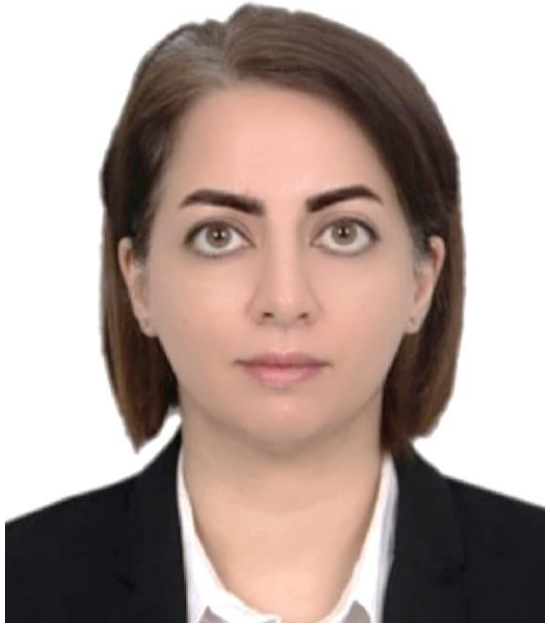
Introduction - Presenter



Dr. Asieh Soltani

- BSc of Railway Engineer
- MSc of Disaster Management
- Doctorate of Business Administration (DBA)

- Accomplished Civil Engineer with over a decade of hands-on experience
- Specializing in railway engineering, RAMS (Reliability, Availability, Maintainability, and Safety), and comprehensive rail project management
- Committed to pioneering innovative solutions while unwaveringly prioritizing
- Joined EIT in November 2020

Agenda

1	Welcome and Introduction
2	The Landscape of Incident Investigation
3	Incident Investigation Process
4	Key Techniques for Incident Investigation
5	Case Studies
6	Continuous Improvement
7	Conclusion and Q&A

Incident Investigation Basics

Accident, Incident, and Near miss Definition

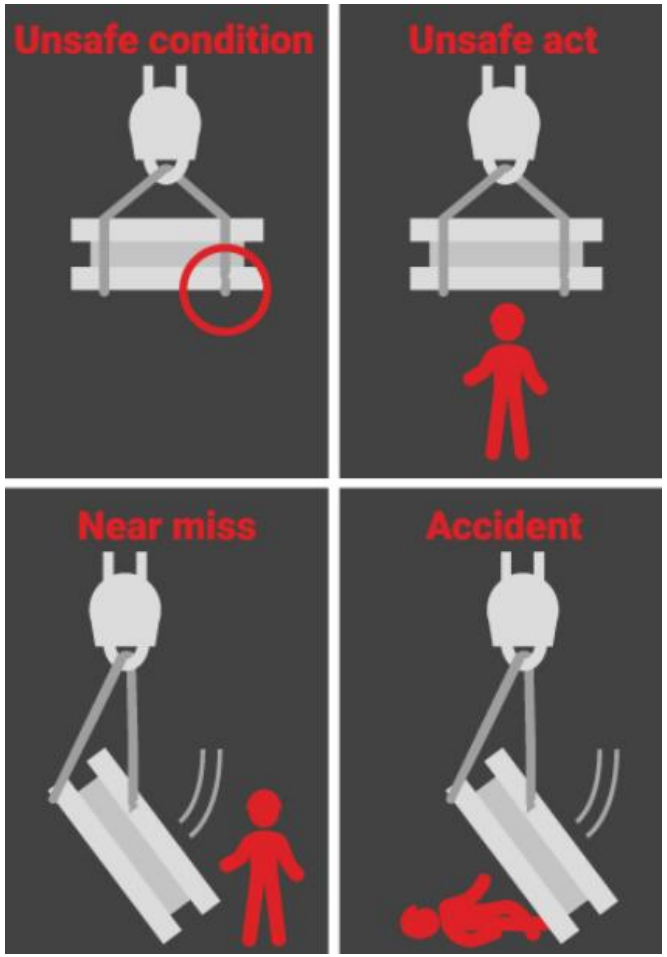
- **An accident** is an undesired event or sequence of events causing injury, ill-health or property damage.
- OSHA defines an accident as an unplanned, unexpected, and not purposefully caused event which occurs suddenly and causes injury or loss, decreased value in resources, and increased liabilities.

- **Near miss:** near misses describe incidents where, given a slight shift in time or distance, injury, ill-health or damage easily could have occurred, but didn't this round.

- **An incident** is an event that could lead to loss of, or disruption to, an organization's operations, services or functions.

- Accidents do not just happen—they are caused, and the key to accident investigation is to find the causes.

Incident Investigation Basics



Accident, Incident, and Near miss Definition

Unsafe conditions: Unsafe equipment/tools which directly cause the accident.

Unsafe actions: Harmful behaviors which contributed to the accident, this can include gaps in safety training for staff.

Direct cause: The result of the condition and/or behavior. The final event which produces an accident.

Surface cause: Hazardous conditions and unsafe employee/management behaviors that produced the accident.

Root cause: The underlying reason the surface cause exists.

Source: https://inunison.io/stay-safe/stay-safe/near-miss-reporting-the-safety-pyramid-part-1/

Incident Investigation Basics

Accident/Incident Investigation Definition

An accident investigation is a **structured process** that attempts to uncover the **sequence of events** that produced or had the potential to produce injury, death, or property damage so that **causal factors** can be determined, and **corrective actions** can be taken.

Consequences of Accidents

Consequences of Accidents

Direct Cost

- Medical cost
- Insurance premiums
- Indemnity payments
- Employee compensation

Indirect Cost

- Time lost by worker
- Overtime
- Pain and suffering
- Administrative time
- Cleanup time
- Equipment repair
- Workers comp increase
- Bad publicity/reputation
- Fines
- Schedule delays
- Loss of job experience
- Training replacement workers
- Loss of production
- Loss of contracts
- Legal fees
- First aid supplies

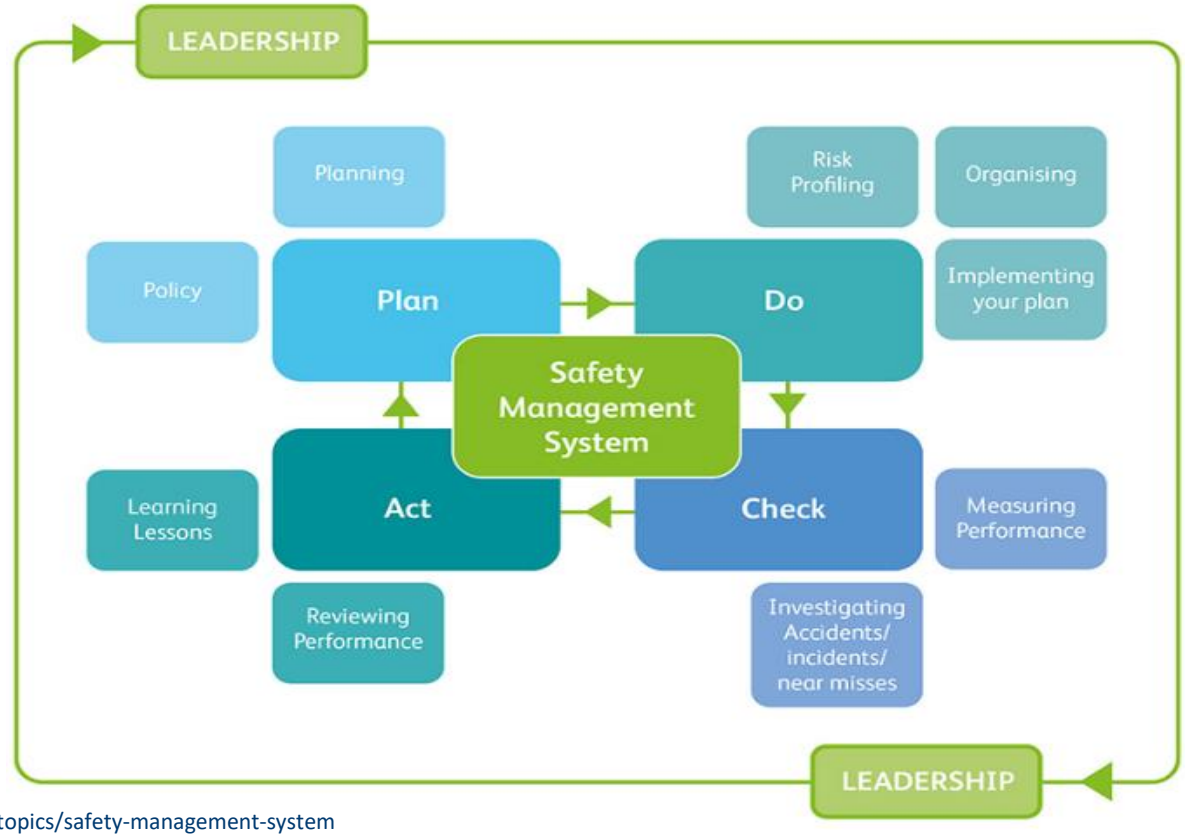
Why investigate?

Why do you investigate a workplace incident? (OSHA)

1. To find the “root cause” of an accident so you can prevent similar accidents from occurring in the future.
2. To fulfill any legal requirements.
3. To determine compliance with OSHA standards.
4. To determine the cost of an incident/accident. (Direct costs may include medical expenses and indemnity payments. Indirect costs may include increased absenteeism, scheduling delays, added administrative time, repairing property damage, and training a replacement worker.)
5. To help your workers’ compensation insurance company process the claim.

The Investigation Process

Safety Management System



Source: https://www.rssb.co.uk/what-we-do/key-industry-topics/safety-management-system

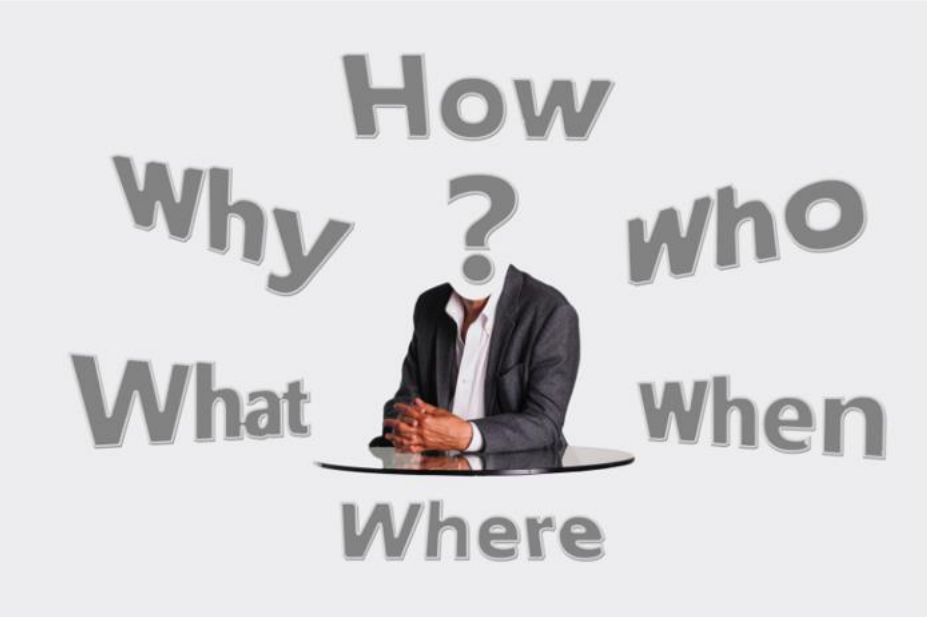
Accident/Incident Investigation

Which events should be investigated?

OSHA strongly encourages employers to investigate all incidents in which a worker was hurt (i.e., accidents), as well as "near misses", in which a worker might have been hurt if the circumstances had been slightly different.

Investigating a workplace incident provides employers and workers the **opportunity** to identify hazards in their operations and shortcomings in their safety programs.

The Investigation Process



Investigation procedure:

1. Visit the scene, gather and record evidence
2. Conduct interviews
3. Evaluate evidence and draw conclusions
4. Write report with recommendations
5. Follow-up

The Investigation Process

Visit the scene, gather and record evidence

1. Ensure Initial Aid and Secure the Scene
2. Visit the Scene
3. Gather and Record Evidence

Why It Matters?

- The significance of accurate evidence gathering in uncovering root causes.

Preparation for an Investigation

Are you ready to investigate?

Emergency Response Actions:

Securing the scene: This could mean turning machines off, cutting power, pulling alarms, etc. The intent is to minimize adverse effects to other employees in the plant.
Providing care to the injured.

Decisions to be made before an investigation begins:

Determine the level of investigation
Decide who will investigate
Decide how much time will be allotted to the investigation
Determine whether additional resources will be needed

ACCIDENT INVESTIGATION PREPARATION TOOLS	
1. **Formal written policy**	A policy that states the reporting process, accident investigation goals, and process of accident investigations.
2. **Emergency response plan and training**	All facilities should have an emergency response plan. While all facilities may not need a dedicated medical staff, they do need trained emergency responders who are prepared to respond to an emergency, administer care, and prevent more damage from being done.
3. **Accident investigation training**	All employees should be trained on how to report accidents and near misses. Employees and supervisors conducting accident investigations should be trained in accident investigation techniques.
4. **Accident investigation kit**	An accident investigation kit is a combination of tools and equipment that aids the accident investigator. It can range from a simple form and a camera to a full setup with tools and equipment. The kit enables the investigator to have all of the equipment he or she needs to start an investigation as soon as an accident occurs.

Source: Accident Investigation Techniques, ©2003, 2012 by the American Society of Safety Engineers

Accident/Incident Investigation

Likelihood of recurrence	Potential worst consequence of adverse event			
	Minor	Serious	Major	Fatal
Certain				
Likely				
Possible				
Unlikely				
Rare				

Risk		Minimal		Low		Medium		High
Investigation level		Minimal level		Low level		Medium level		High level

Types of accidents/incidents to investigate:

Serious and Major: usually investigated automatically.

Minor and Near-Miss: indicators that point to a condition or practice that, if allowed to continue, could cause injury or equipment damage.

Investigations of serious accidents often reveal earlier incidents of a similar nature that have been dismissed as insignificant.

All accidents/incidents with the potential for loss should be investigated.

Source: https://www.ask-ehs.com/blog/the-study-why-incident-investigation-and-reporting-is-important/

The Investigation Process

TYPES OF EVIDENCE
Physical Evidence—Hardware and solid material related to the accident.
Paper Evidence—Any type of written documentation related to the accident.
People Evidence—The evidence that is gathered from people, usually in the form of statements or interviews.
Photographic or Picture Evidence—Media that can document the scene and transfer knowledge.

Investigation procedure:

1. Visit the scene, gather and record evidence
2. Conduct interviews
3. Evaluate evidence and draw conclusions
4. Write report with recommendations
5. Follow-up

Source: https://www.pembinatrails.ca/WhatWeOffer/SafetyHealthandEnvironment/Safety/Accident-Reporting/Pages/Accident-Investigations.aspx

The Investigation Process

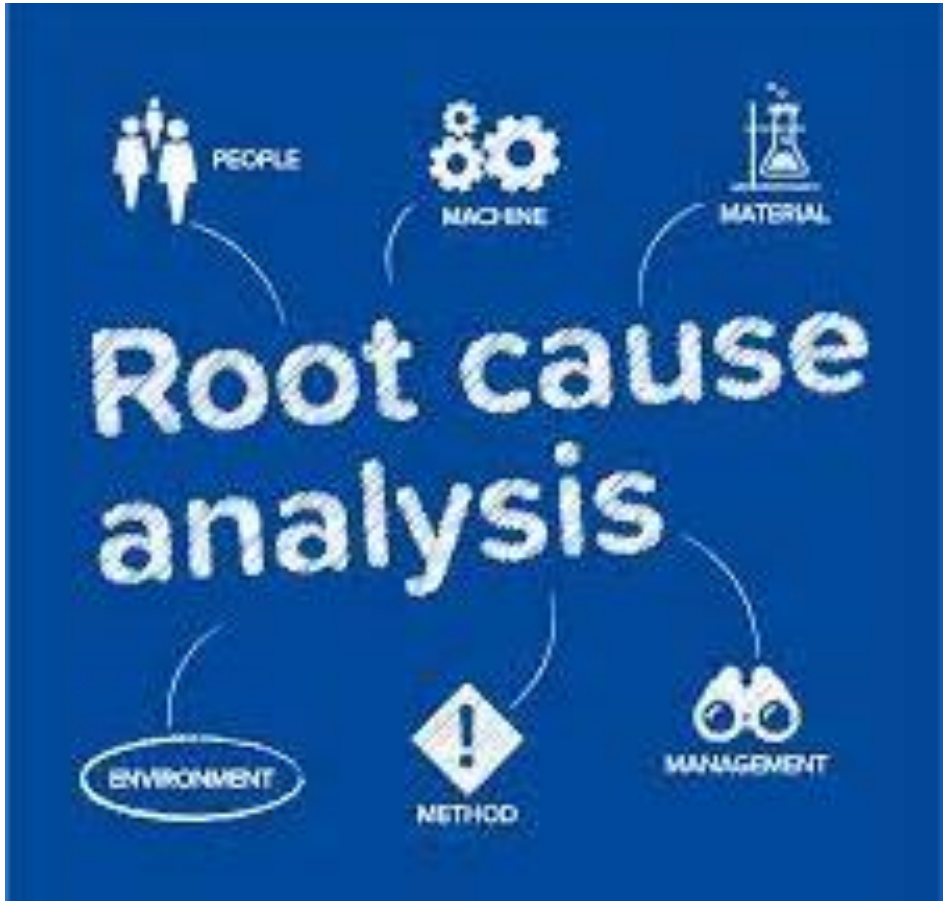
GOOD INTERVIEWING SKILLS	
ESTABLISH COMMUNICATIONS	**ASK QUESTIONS**
• Explain the purpose of the interview. • Explain the purpose of the accident investigation. • Do not rush the interview. • Be friendly and professional. • Do not start with rapid-fire questions. • Make the interviewee feel that he or she is an important part of the investigation process. • Do not judge, become angry, refute, or suggest. • Obtain the interviewee's job title, experience, education, training, etc.	• Ask open-ended questions to get the interviewee's view of the accident. • Have specific questions ready. • Obtain specific times and dates for each event. • Always ask what caused the accident and what could have prevented it. • Always end positively.

Conduct interviews:

1. The role of interviews in gaining firsthand accounts.
2. The need for structured and unbiased questioning.
3. The importance of interviewing witnesses, involved parties, and relevant personnel.
4. Tips on effective interview techniques, such as active listening.

Source: Accident Investigation Techniques, ©2003, 2012 by the American Society of Safety Engineers

The Investigation Process



Source: https://precisebusiness.com/how-to-root-cause-analysis-2/

Evaluate Evidence and Draw Conclusions:

- There are many theories about why and how accidents occur and understanding them is important.
- An **accident investigation** is the process of breaking down information into pieces until the investigator understands what happened; then the investigator can analyze the pieces to determine ways to prevent the accident from recurring.
- Each accident investigator and company has a view about how accidents occur and which theories they prefer.
- Analytical techniques will help you to make a smooth and consistent transition from facts to causal factors.

Data Analytics in Incident Investigation

Accident/incident investigation and analysis

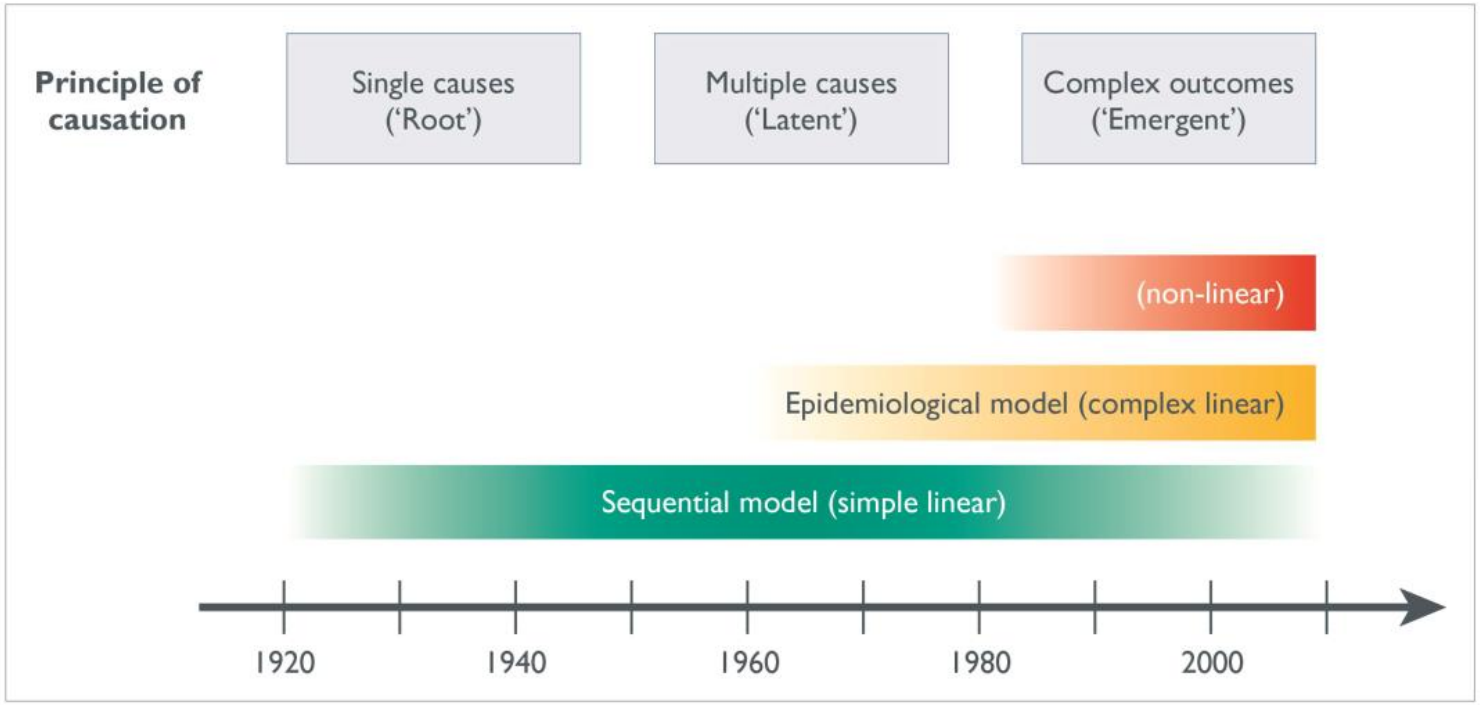
There are many methods of analysing the information gathered in an investigation to find the immediate, underlying and root causes and it is for you to choose whichever method suits you best.

The value of an accident causal model is to conduct accident analysis and prevention.

Data Analytics in Incident Investigation

Accident/incident investigation analysis models

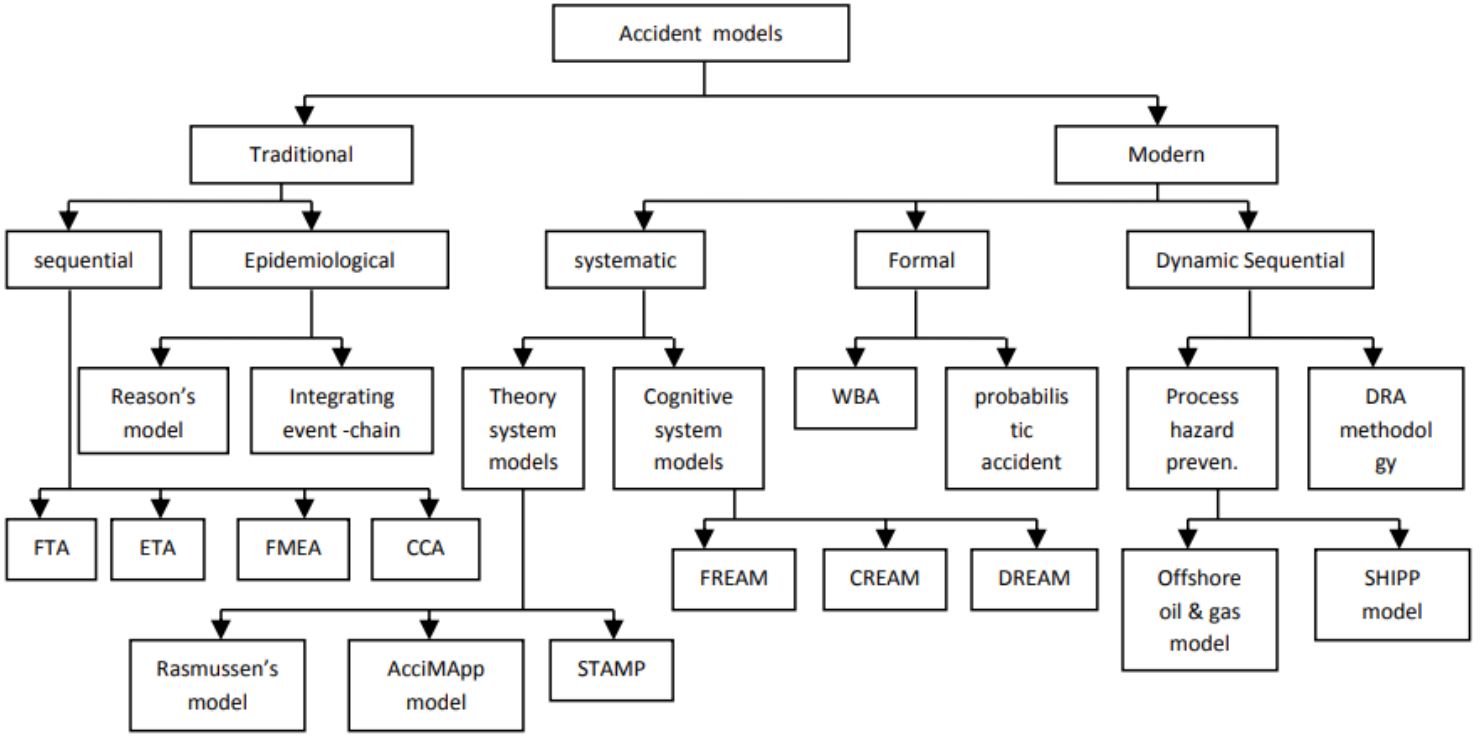
- Sequential Techniques
- Epidemiological Techniques
- Systemic Techniques



Source: https://www.ohsbok.org.au/wp-content/uploads/2013/12/32-Models-of-causation-Safety.pdf

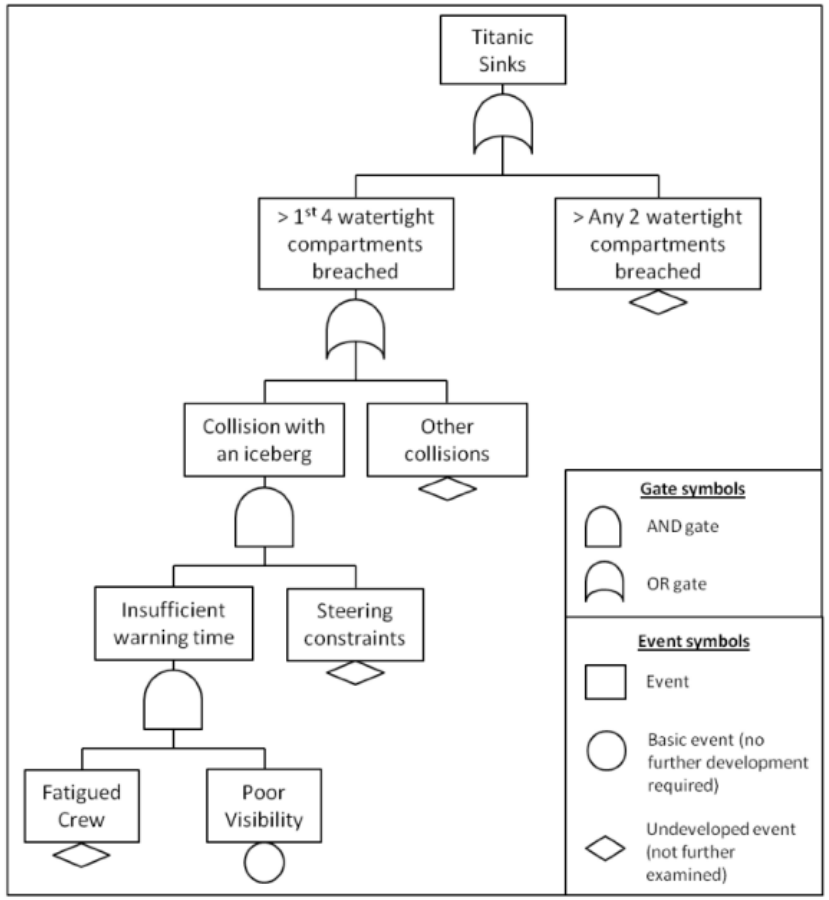
Accident Investigation Model Categories

Accident model classification



Source: https://www.aidic.it/cet/15/43/207.pdf

Sequential Techniques



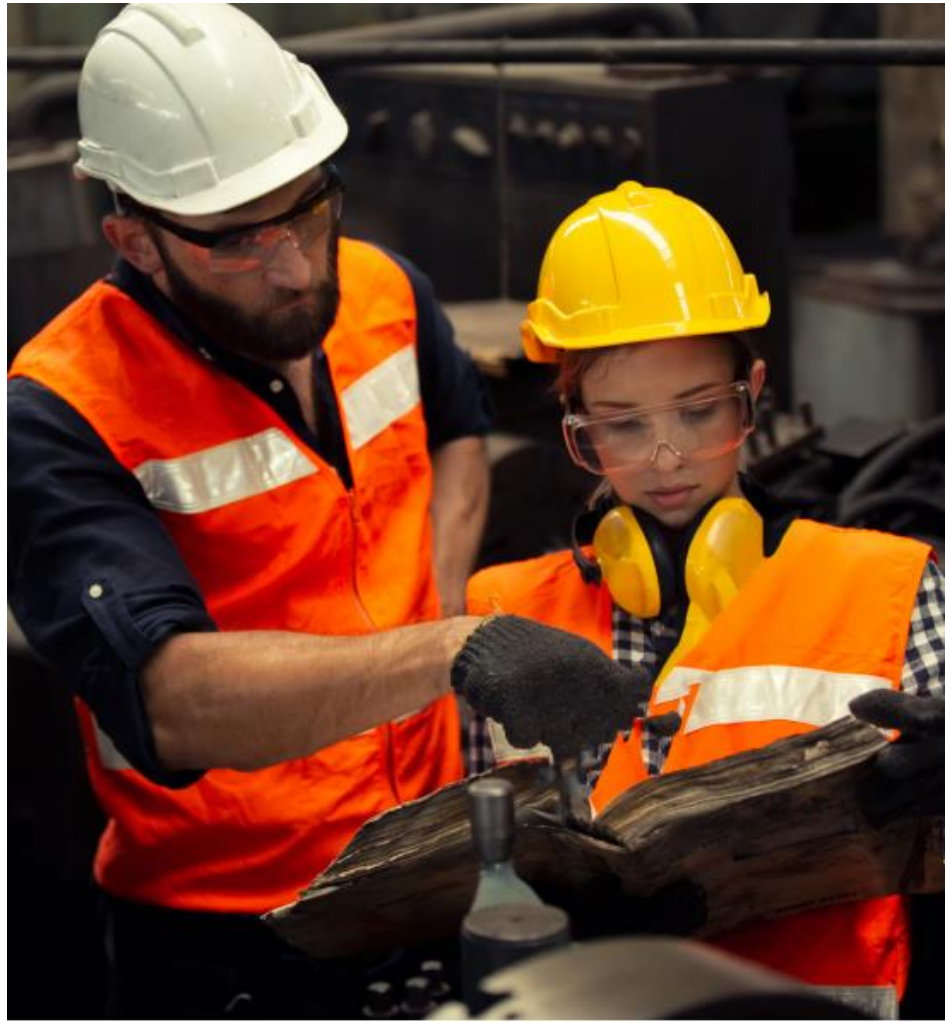
Sequential Techniques

These methods work well for losses caused by physical component failures or the actions of humans in relatively simple systems and generally offer a good description of the events leading up to an acciden , events in a step-by-step chronological order.

- The importance of establishing a timeline for events.

Rachel A. Haga, Joseph H. Saleh, and Cynthia C. Pendley. “Reexamining the titanic with current accident analysis tool: Multidisciplinary eduation and system safety primer for engineering students”. In: IEEE Global Eng Edu Conf , EDUCON IEEE Global Engineering Education Conference, EDUCON (2013), pp. 1032–1041. issn: 9781467361101.

Sequential Techniques



Practical Example of Sequential Techniques:

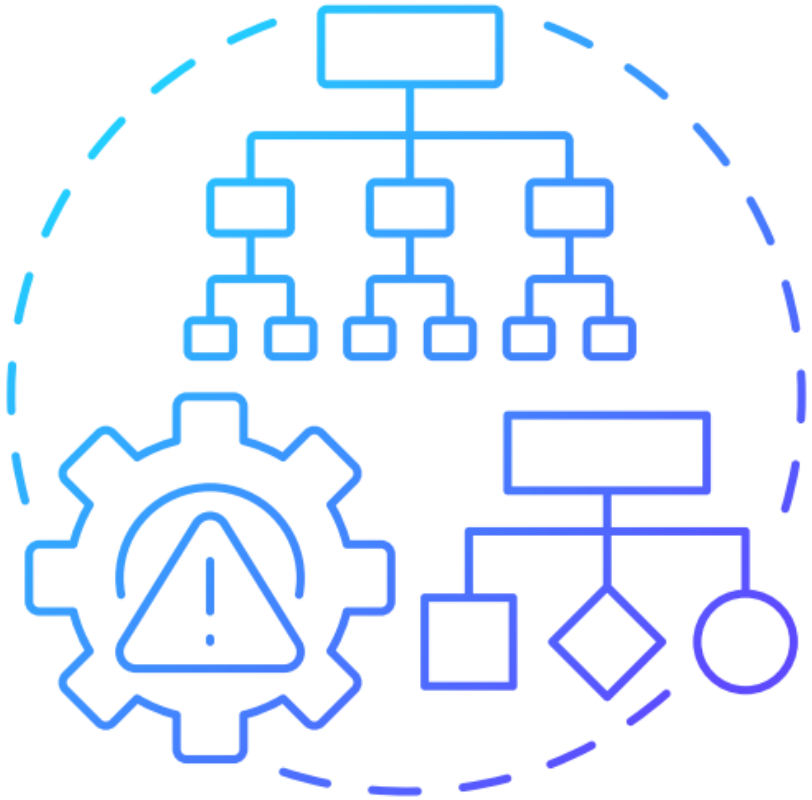
Example: Manufacturing Incident

Incident: Machine malfunction leading to production stoppage.

Sequential Analysis: Identified a sequence of maintenance delays, resulting in the malfunction.

Outcome: Improved maintenance scheduling to prevent future disruptions.

Sequential Techniques



How it Identifies Causation Links:

- Sequential analysis breaks down events into a chronological order.
- By examining the sequence, it becomes evident how one event led to another, revealing direct causation links.

Sequential Techniques

Pros and Cons of Sequential Techniques:

Advantages:

- Clear Understanding
- Root Cause Identification
- Practical Solutions

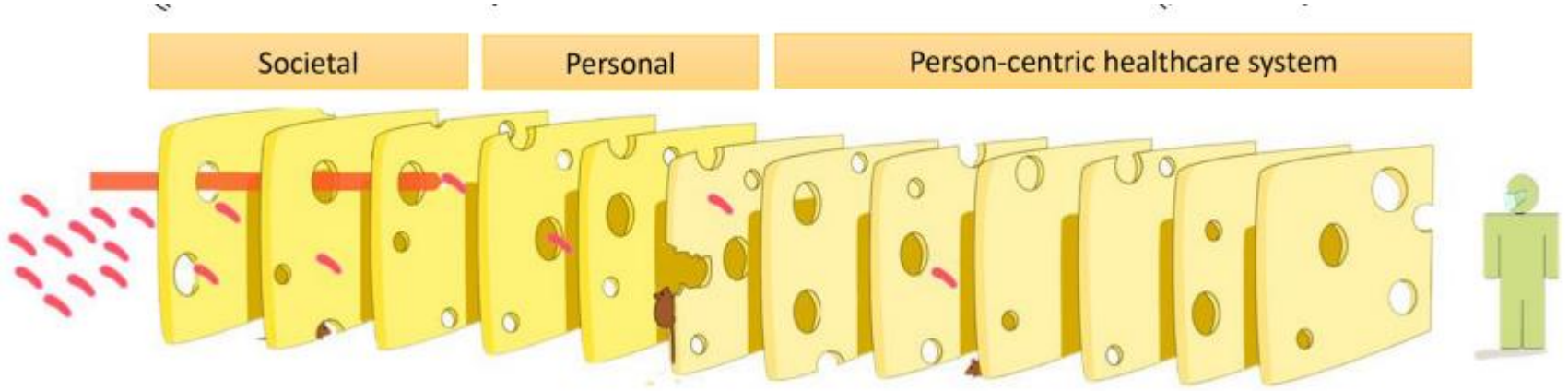
Limitations:

- Simplicity
- Subjectivity
- Isolated View

Epidemiological Techniques

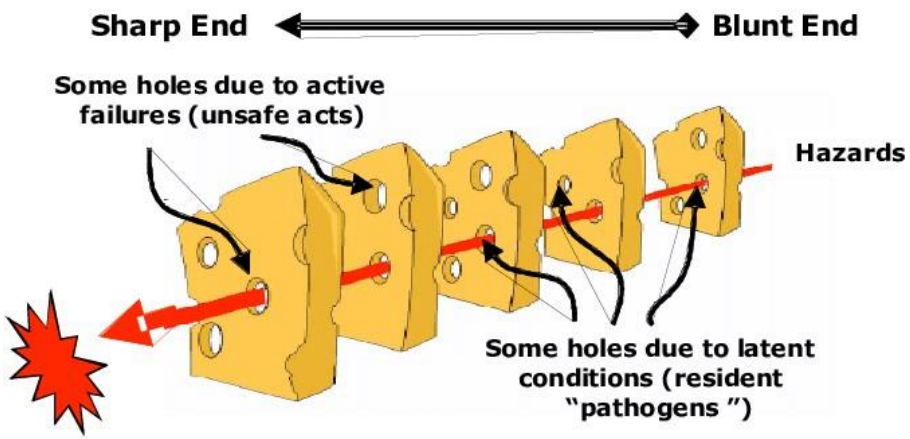
Epidemiological Techniques

Epidemiological models and methods view accidents as a combination of ‘latent’ and ‘active’ failures within a system, analogous to the spreading of a disease (Qureshi, 2007).



Source: Zimmer AJ, et al. J Epidemiol Community Health 2021;0:1–7. doi:10.1136/jech-2021-217529

Epidemiological Techniques



Practical Application of Epidemiological Analysis

Traditional Swiss Cheese Layers representing organizational defenses – policies, procedures, and training.

Additional Complexity Layers:

- Cultural Layer
- Technological Layer
- Human Factor Layer

Source: https://www.researchgate.net/figure/Swiss-cheese-model-of-accident-causation-Reason-1997_fig3_228683461/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6Il9kaXJlY3QiLCJwYWdlIjoiX2RpcmVjdCJ9fQ

Epidemiological Techniques

Practical Example of Epidemiological Analysis

Incident: Workplace exposure to a hazardous substance.

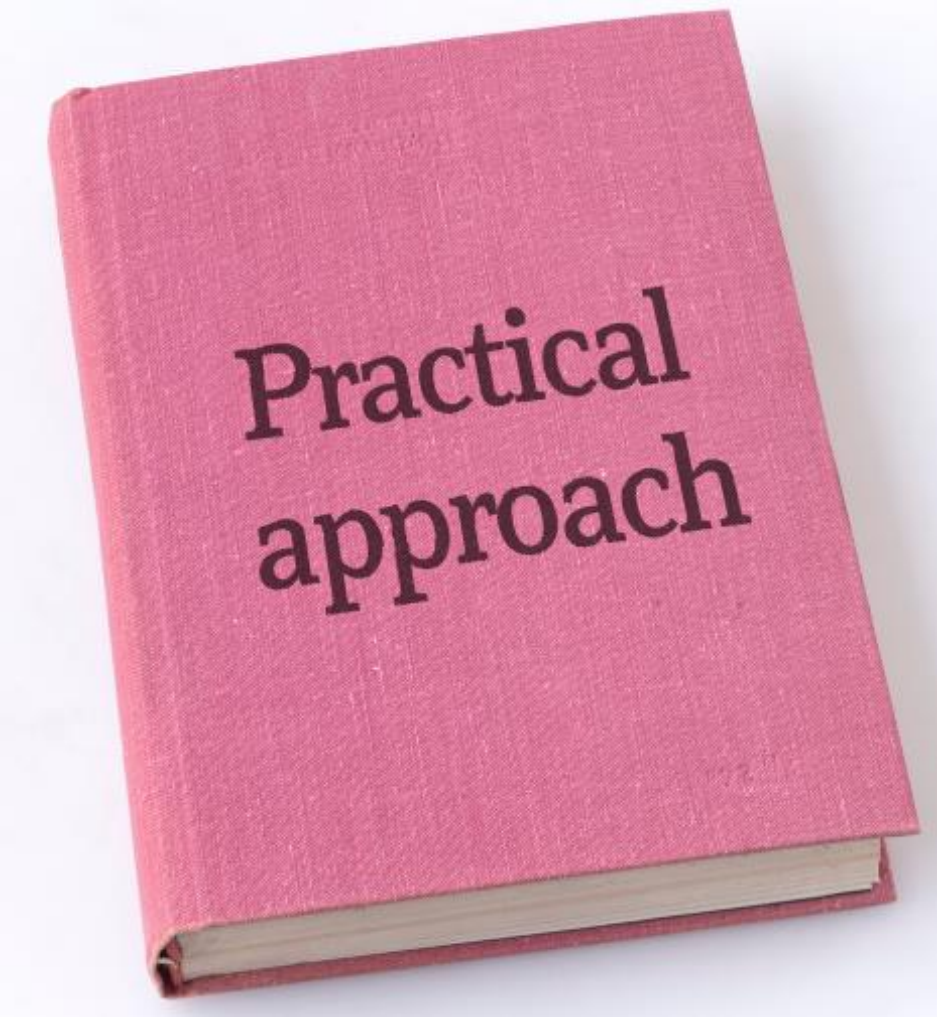
Data Analysis: Time: Most incidents occur during the night shift.

Location: Concentrated in a specific work area.

Demographics: Higher incidence among new employees.

Outcome: Epidemiological analysis reveals a pattern suggesting a need for targeted training for new employees working in the identified area during night shifts.

Epidemiological Techniques



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Epidemiological Techniques

Epidemiological Techniques - Pros and Cons

Advantages:

Data-Driven Insights

Preventive Strategies

Identification of Vulnerable Groups

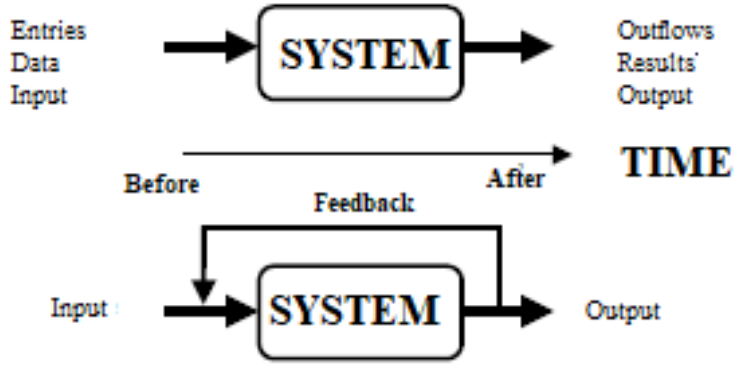
Limitations:

Data Availability

Complexity

Limited to Observable Factors

Systemic Techniques

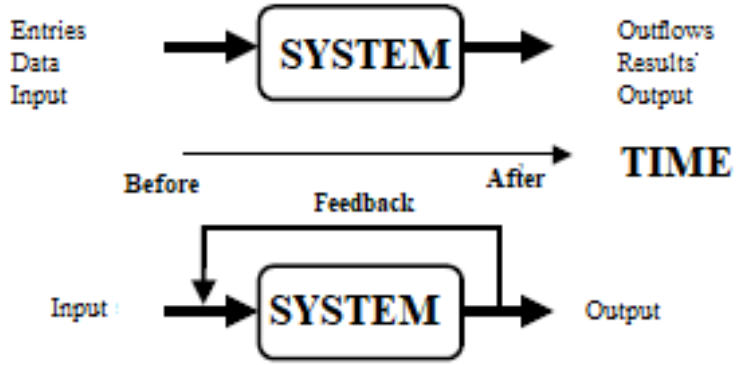


Systemic Techniques

Systems theory is designed to understand the structure and behaviour of any type of system. Rather than treating accidents as a sequence of cause-effect events, it describes losses as the unexpected behaviour of a system resulting from uncontrolled relationships between its constituent parts.

A range of systemic tools exist which enable the application of the systems approach, e.g. the Systems Theoretic Analysis Model and Processes model (STAMP) (Leveson, 2004, 2011), the Functional Resonance Analysis Method (FRAM) (Hollnagel, 2004, 2012) and the Accimap (Rasmussen, 1997).

Systemic Techniques



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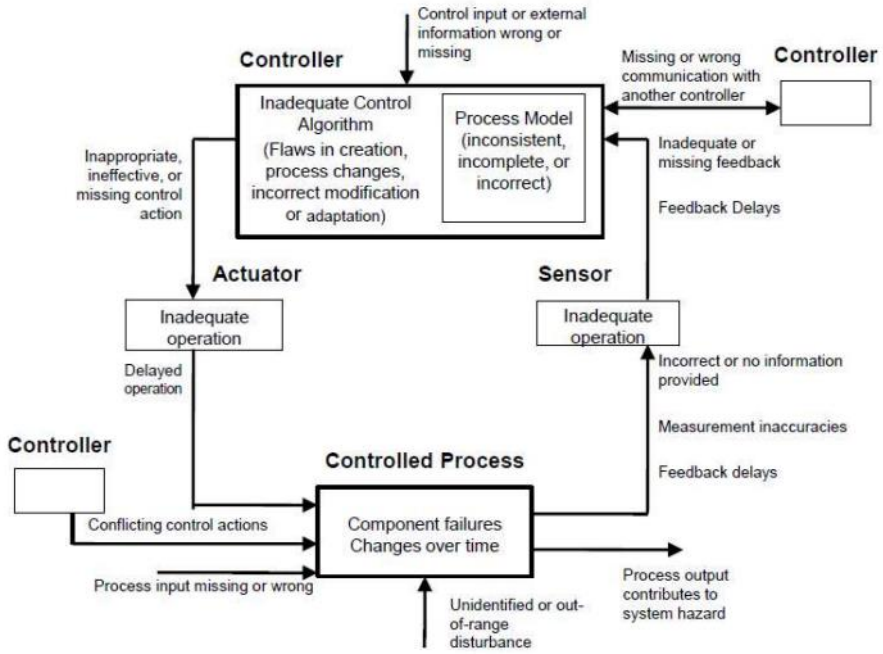
Systemic Techniques

Systems-Theoretic Accident Model and Process (STAMP)



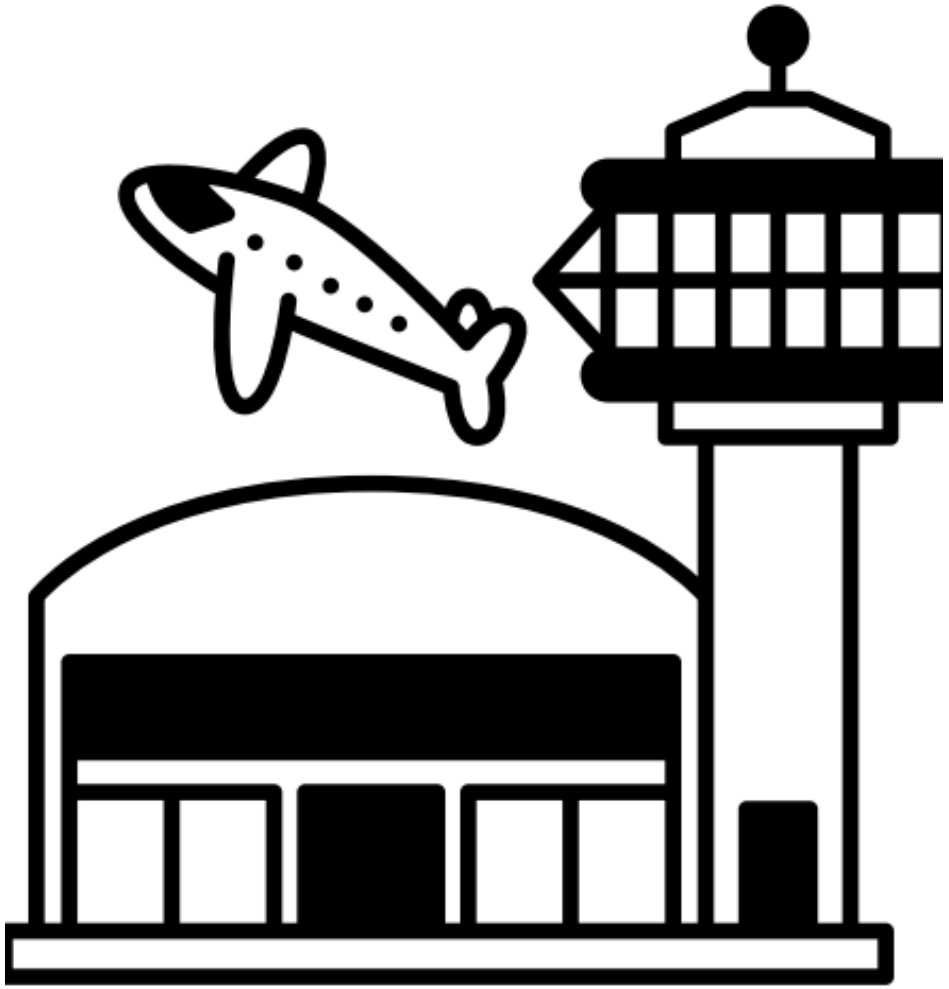
The STAMP approach as a systems-theoretic model.

system components, interactions, and the role of constraints.

STAMP can be applied to analyze accidents by examining control structures, information flow, and feedback loops.

Nancy Leveson. “A new accident model for engineering safer systems”. In: Safety Science 42.4 (Apr. 2004), pp. 237–270. issn: 0925-7535. doi: 10.1016/s0925-7535(03)00047-x.

Systemic Techniques



STAMP Analysis in Aviation Incident

Identifying Control Structures

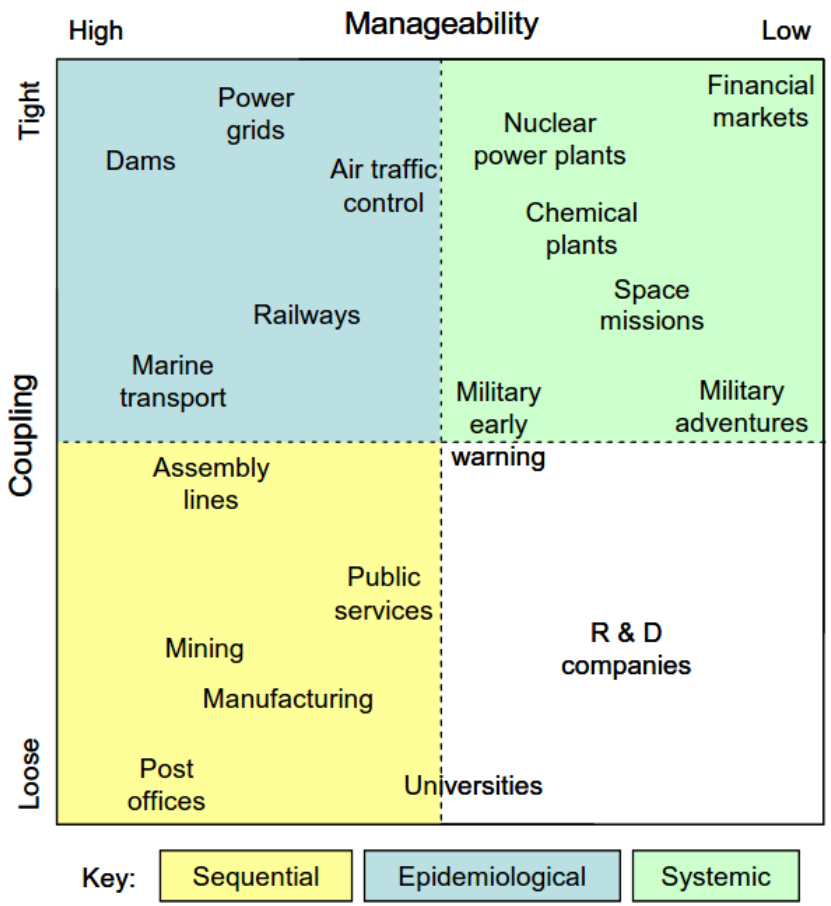
Analyzing Information Flow

Assessing Feedback Loops

Identifying Latent Systemic Weaknesses

Recommendations and Improvements

Analysis technique suitability



Analysis technique suitability (adapted from Hollnagel (2008))

In order to choose which category of analysis technique best suits an individual's needs, a useful starting point is to consider the type of system being analysed.

Source: https://www.researchgate.net/publication/259339662_Accident_Analysis_Models_and_Methods_Guidance_for_Safety_Professionals

The Investigation Process

Investigation procedure:

1. Visit the scene, gather and record evidence
2. Conduct interviews
3. Evaluate evidence and draw conclusions
4. Write report with recommendations
5. Follow-up

The Investigation Process

Reporting and documentation:

- Accident reports should be written for major accidents, injuries, fatalities, property damage, and even near misses with potential for major injury or damage.

- Accident reports should, at a minimum, contain:

1. Methodology.
2. Introduction.
3. Sequence of events (a thorough accident description).
4. Facts and analysis.
5. Causal factors.
6. Corrective actions.
7. Conclusions and summary.

The Investigation Process

Investigation procedure:

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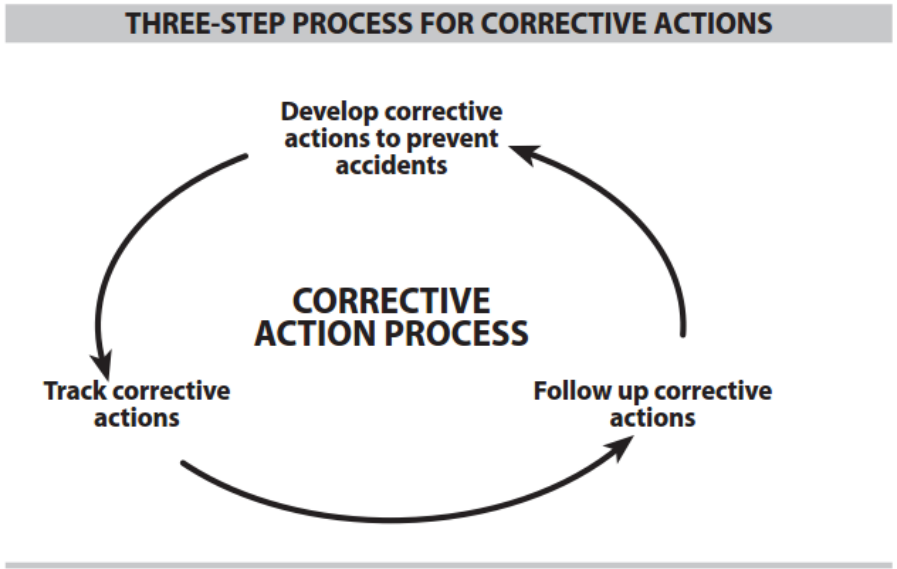
The Investigation Process

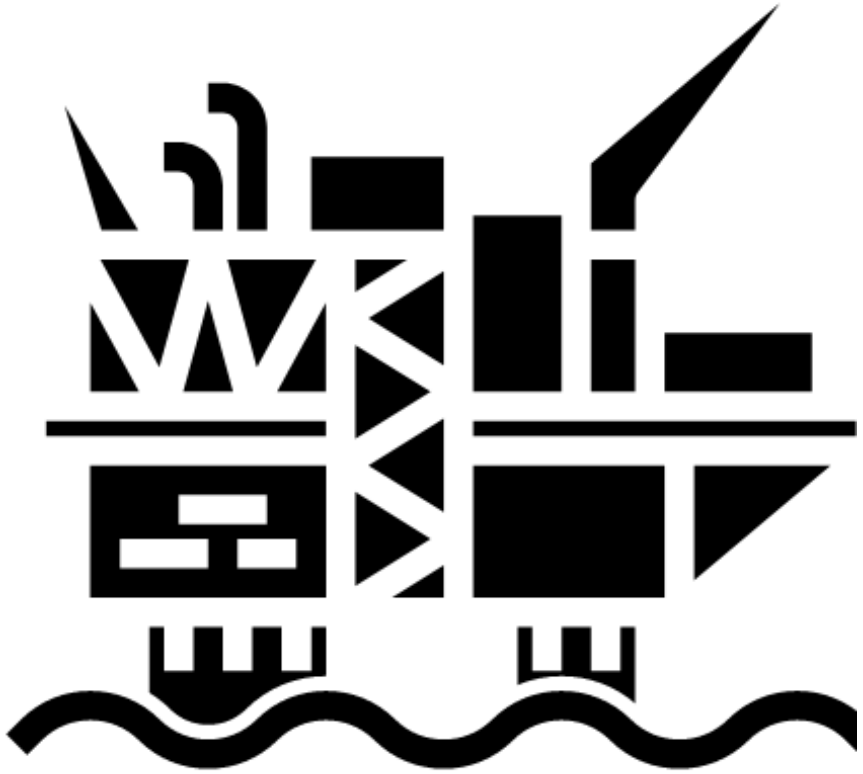


Follow-up steps:

- Check that the **corrective action** has been **completed** correctly.
- Make certain the corrective action works to prevent accidents.
- Ensure that the corrective action is being used.
- Be proactive.

Source: Accident Investigation Techniques, ©2003, 2012 by the American Society of Safety Engineers

The importance of Accident Investigation



The Piper Alpha Disaster

Lord Cullen stated in his report into the accident [Cullen 1990]:

Management shortcomings emerged in a variety of forms:

- ✓ No clear procedure for shift handover.
- ✓ The permit to work system was inadequate.
- ✓ Training, monitoring and auditing had been poor
- ✓ The lessons from a previous relevant accident had not been followed through.
- ✓ Evacuation procedures had not been practiced adequately.
- ✓ There had no adequate assessment of the major hazards and methods for controlling them.

The importance of incident investigation

The importance of incident investigation

- Some Near misses had not been investigated properly:

✓ Inadequate fire suppression systems

✓ lack of training for workers

✓ temporary shutdown of the platform's oil production

✓ a gas leak that occurred in July 1988 prior to the Piper Alpha disaster

Source: Wood Group HSE Matters. Company Report 2008- Article The lessons of Piper Alpha.

Learning From Disaster

Learning From Piper Alpha Disaster

- Management is responsible.
- A systematic approach is required.
- Quality of safety management is critical.
- Auditing is vital.

Continuous Improvement

Learning and Adapting from Experience

Learning From accidents

Incident Investigation Feedback Loop:

1. Post-Incident Analysis
2. Feedback Mechanism

Near Miss Reporting

Benchmarking and Industry Collaboration

Continuous Improvement Metrics

Conclusion:

- There are many **theories** about *why and how* accidents occur and understanding them is important.
- Accidents do not just happen—they are caused, and the key to accident investigation is to find the causes.
- An accident investigator must understand **how an accident occurs** in order to properly analyse it, find its causes, and prevent future accidents.
- Each accident investigator and company has a view about how accidents occur and which theories they prefer.
- **Understanding why accidents occur** and **how to prevent their recurrence** is an essential part of improving safety in any industry.

Thank you!

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Undergraduate Certificate in Civil Engineering	12 February 2024
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Q&A

Engineering Institute of Technology.

Website
www.eit.edu.au

Head Office
1031 Wellington Street West Perth
Perth, WA 6005

Phone
Inside Australia: 1300 138 522
Outside Australia: +61 8 9321 1702

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webinars@eit.edu.au

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