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The Importance of Systemic View in Accident/Incident Investigation

Thursday, 28th July 2022 | Technical Topic Webinar

Presented by Dr. Asieh Soltani, EIT Lecturer

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Introduction - Presenter

Dr. Asieh Soltani

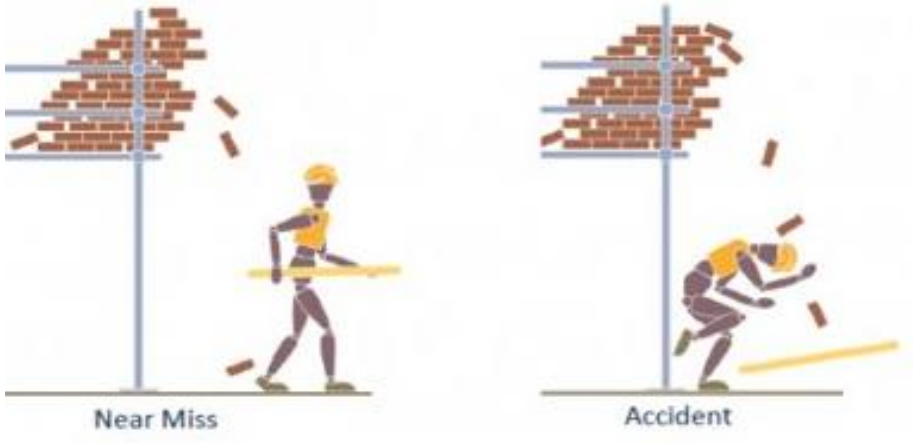
- BSc of Railway Engineer
- MSc of Disaster Management
- Doctorate of Business Administration (DBA)

- Railway engineer
- Risk Management Professional
- 15 years of experience in light/heavy rail transportation systems design and construction
- Joined EIT in November 2020

Agenda

1	Welcome and Introduction
2	What Is an Incident/Accident?
3	The Importance of Incident/Accident Investigation
4	Incident/Accident Investigation Stages
5	Accident Investigation Model Categories
6	Systemic View in Incident/Accident Investigation
7	Conclusion and Q&A

Accident and Incident



Accident and Incident Definitions

An accident is an undesired event or sequence of events causing injury, ill-health or property damage.

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.

Investigating accidents and incidents
A workbook for employers, unions, safety representatives and safety professionals HSE books

Accident and Incident

Accident and Incident Definitions

Event: A change of state in the system that is important enough to give it a name.

Action: The fact or process of doing something, typically to achieve an aim

Condition: A state of the world that enables a certain class of state changes.

Barrier: A state of the world that inhibits a certain class of state changes.

Accident and Incident

What is the connection between the iceberg and the topic?

Accident/Incident Investigation

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.

Accident/Incident Investigation

Why do we investigate incidents/accidents?

To determine the accident and incident cause.

To determine the cost of an accident.

To avoid spending money on accidents in the future

To prevent future accidents

To comply with the law and determine the total cost of an accident

To identify the sequence of events leading to the accident.

To fulfill the legal requirement;

To determine compliance with applicable safety regulations

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.

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.

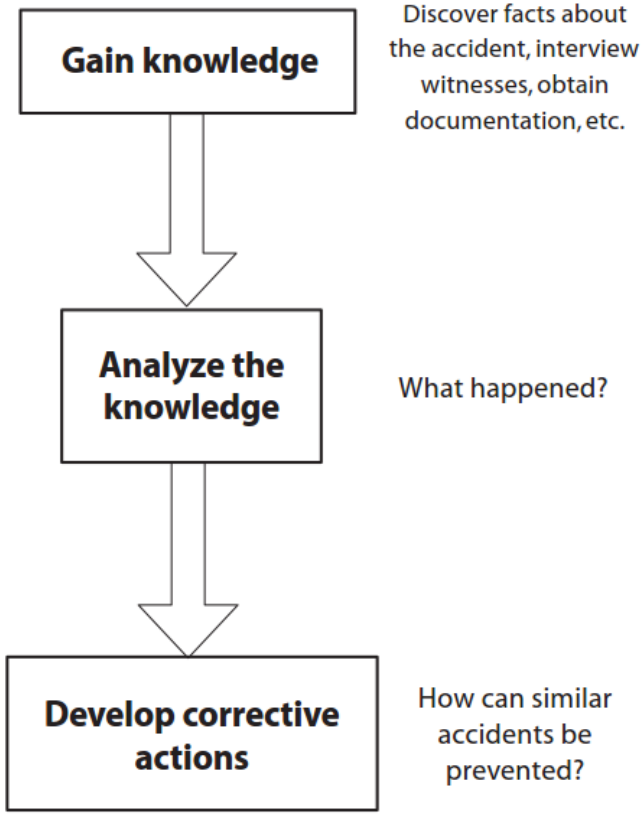
Minor and Near-Miss: indicators that point to a condition or practice that, if allowed to continue, could cause injury or equipment damage.

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/

Incident/Accident Investigation



Stages of Incident/Accident Investigation

Investigation of workplace accidents and incidents is an essential part of the proactive management of health and safety.

Source: Accident Investigation Techniques - Basic Theories, Analytical Methods and Applications, 2nd Edition, by J. S. Oakley

Incident/Accident Investigation Stages

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

Incident/Accident Investigation Stages

Visit the scene, gather and record evidence

- Emergency Response Actions
- Taking Control of the Accident Scene
- Assign Investigation Team
- Planning
- Collecting Initial Site Information
- Determining Task Assignments, Preparing a Schedule
- Coordinating Internal and External Communication

Incident/Accident Investigation Stages

Types of Evidence (the 4 Ps)

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.

Incident/Accident Investigation Stages

Conduct interviews

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.

Incident/Accident Investigation Stages

Evaluate evidence and draw conclusions

There are many theories about why and how accidents occur and understanding them is important.

An accident investigator must understand how an accident occurs in order to properly analyze 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.

Incident/Accident Investigation Stages

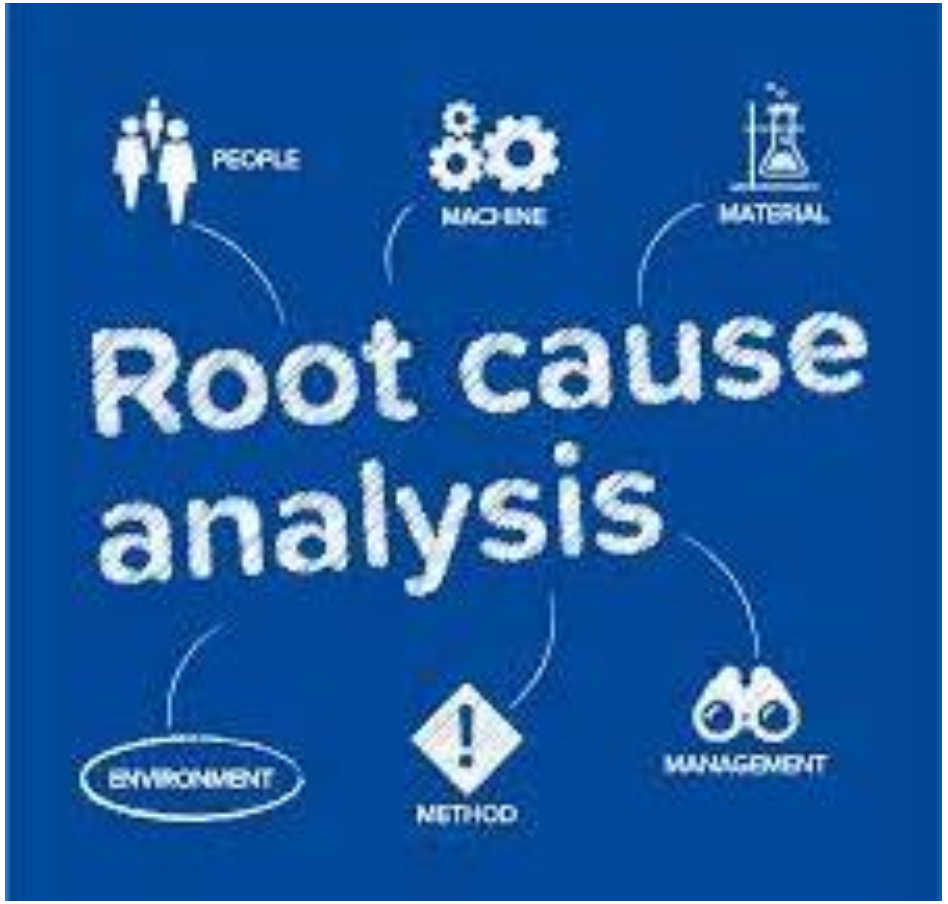
Evaluate evidence and draw conclusions

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.

Asking “why” is a crucial first step in discovering the **causal factors** of an accident.

The events or circumstances that contribute to an accident are called **causal factors**. Correction of these causal factors at whatever level they may occur is what ensures that a particular incident will not recur.

Accident/Incident Investigation



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

the benefits of using analytical techniques

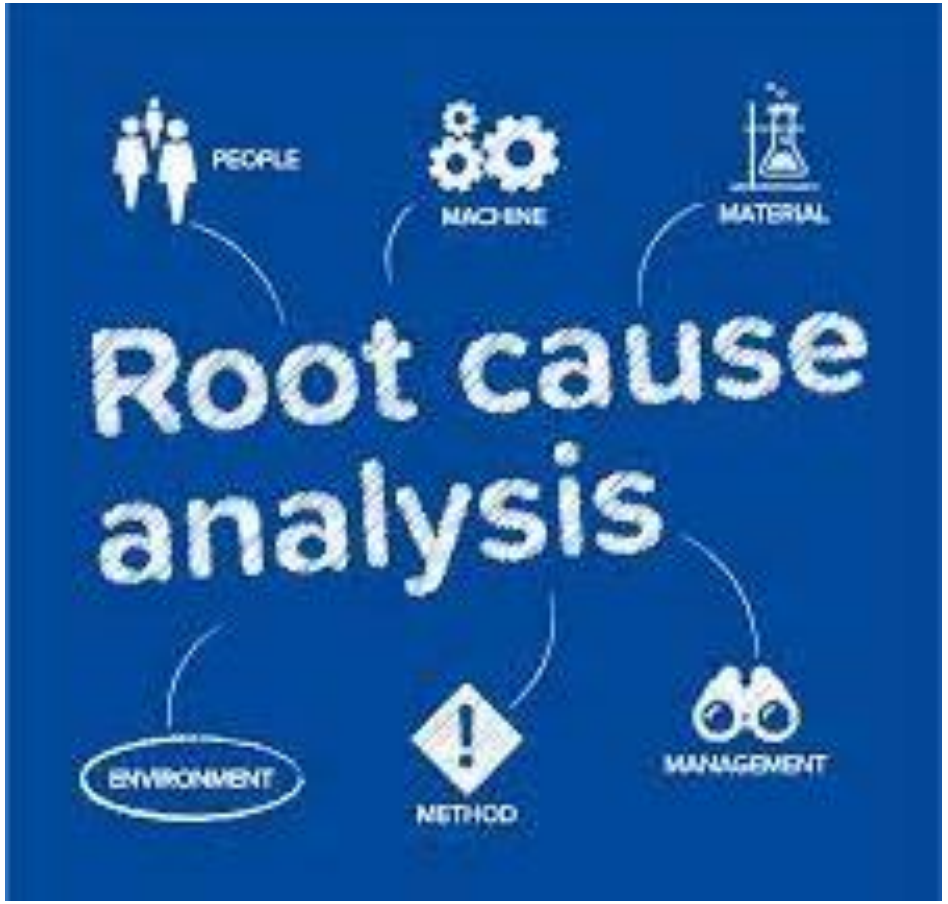
If you do not use analytical techniques, it is very easy to find only lower-level causal factors and miss the systemic factors.

Analytical techniques will help you to make a smooth and consistent transition from facts to causal factors.

The thoroughness of the analytical techniques will give you confidence that your investigation determined what really happened and that your recommendations will prevent future accidents.

Using analytical techniques for every accident investigation lends consistency to your safety program.

Accident/Incident Investigation



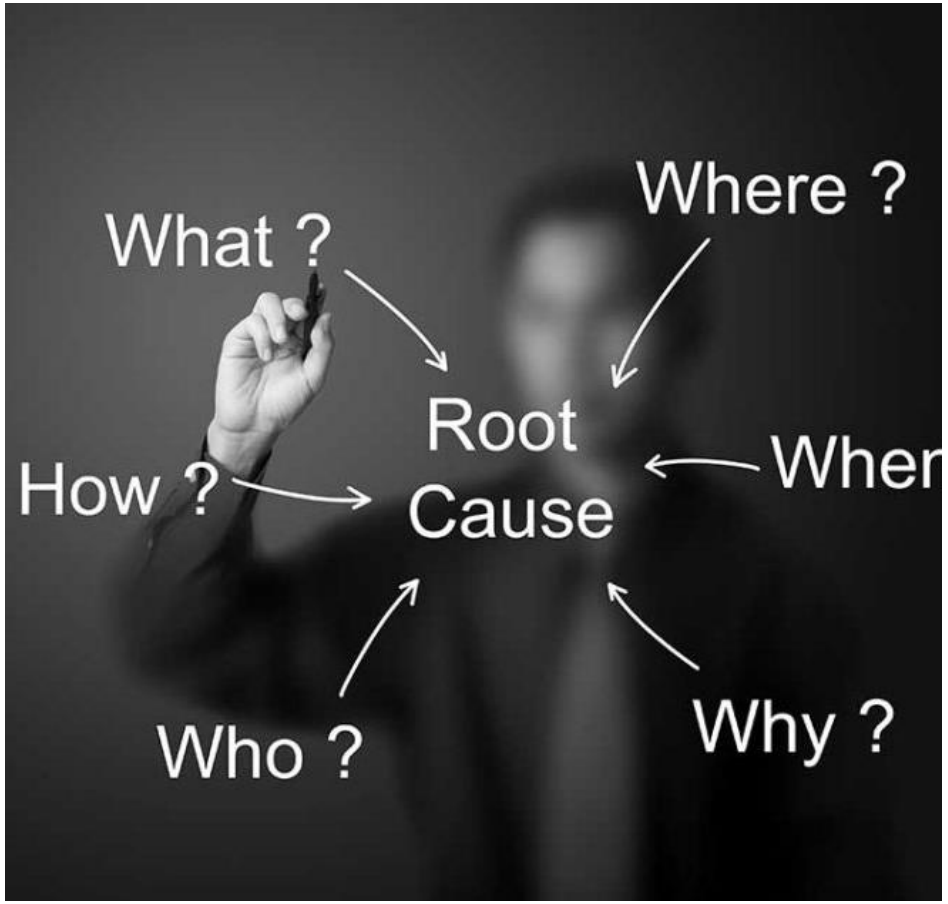
Source: https://precisebusiness.com/how-to-root-cause-analysis-2/

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.

Accident/Incident Investigation



Causal factors:

Understanding why accidents occur and how to prevent their recurrence is an essential part of improving safety in any industry.

the immediate causes

underlying causes

root causes

Accident/Incident Investigation

Causal factors:

WHO was involved or injured? Were there witnesses?

WHERE did the accident/incident happen?

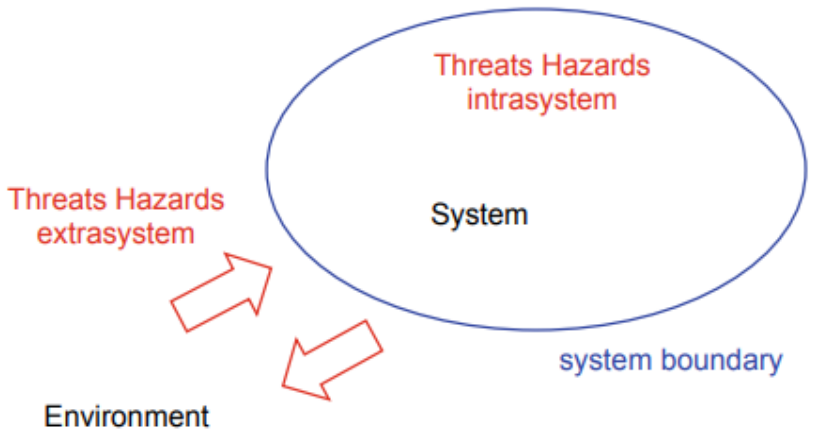
WHEN did the accident/incident occur?

WHAT were the immediate and basic causes?

WHY was the unsafe act or condition permitted?

HOW can a similar accident/incident be prevented?

System Characteristic



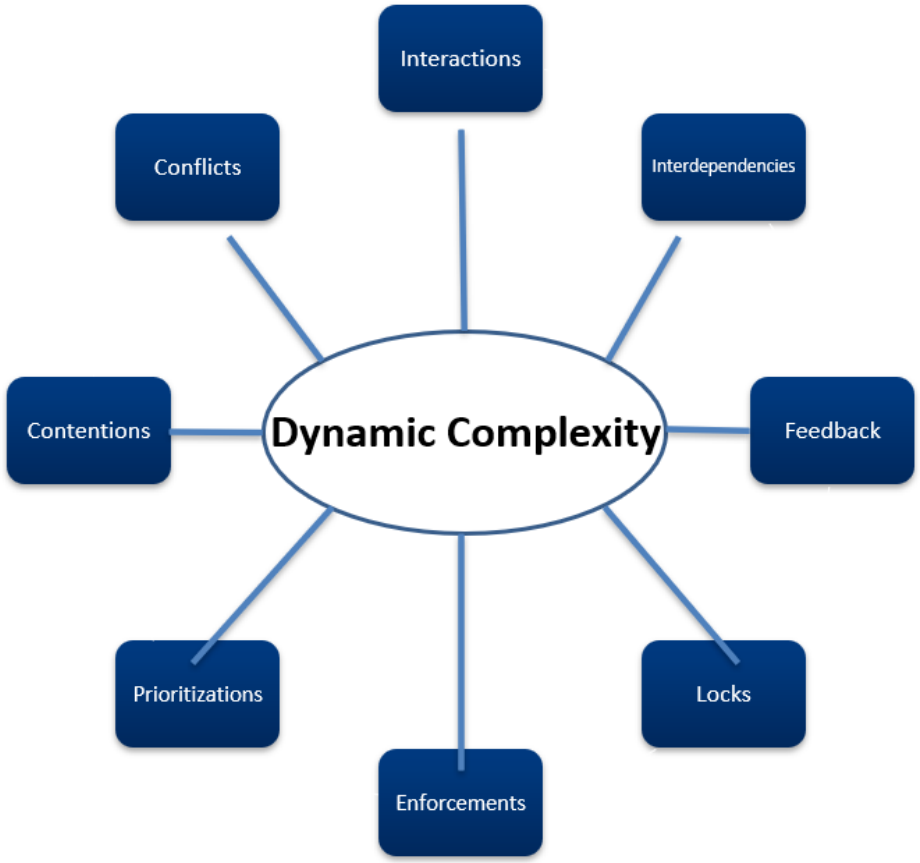
Engineered Systems

Accident models based on systems theory consider accidents as arising from the interactions.

Whereas industrial (occupational) safety models focus on unsafe acts or conditions and reliability, engineering emphasises failure events and the direct relationships between these events, a systems approach takes a broader view of what went wrong with the system's operation or organisation to allow the accident to take place.

The Coupling of Safety and Security, Book in Springer Briefs in Applied Sciences and Technology · August 2020

System Characteristic



Dynamic Complexity

Dynamic complexity results from hidden, unknown factors - or more precisely, interactions between factors - that can unexpectedly impact the performance of systems.

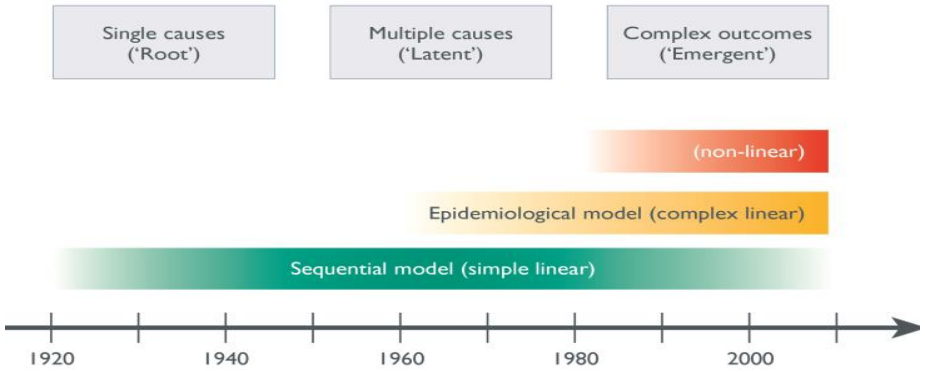
Source: Key Concepts /by Nabil Abu el Ata

System Characteristic

Dynamic complexity creates risk!

In most cases the unknown risks are caused by dynamic complexity, which lies hidden like a cancer until the symptoms reveal themselves.

Accident Investigation Model Categories

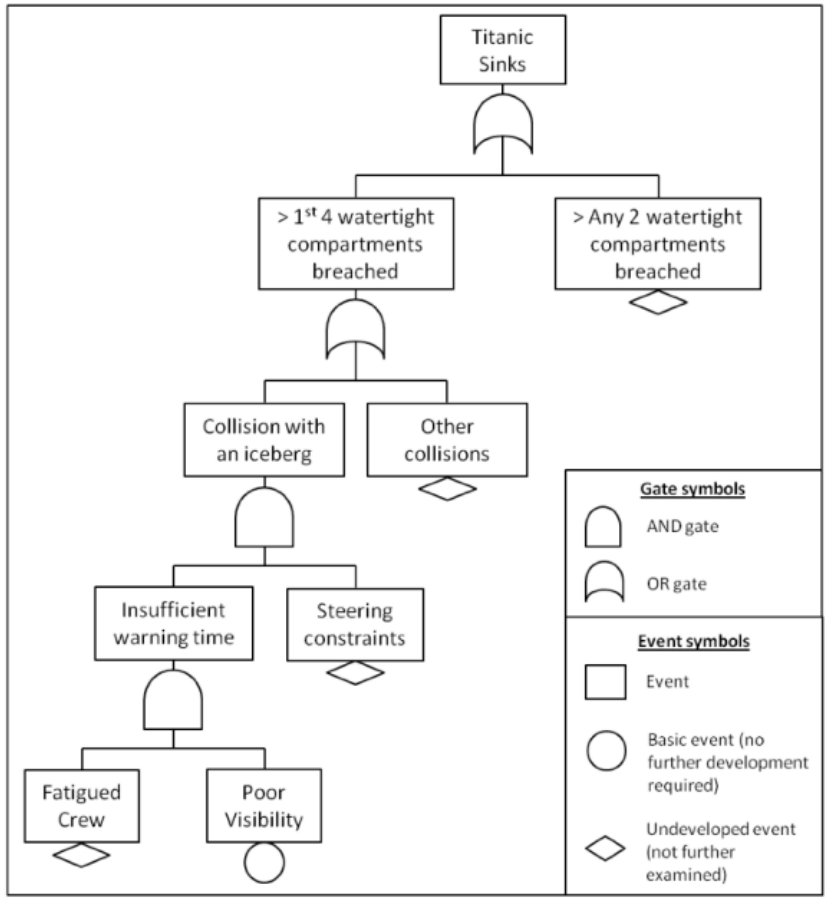


Accident Investigation Model Categories

A key driver for the continued rise in analysis model and method numbers is the ever-increasing complexity of socio-technical systems and the resulting change in accident causation mechanisms.

- Sequential Techniques
- Epidemiological Techniques
- Systemic Techniques
- Other

Sequential Techniques

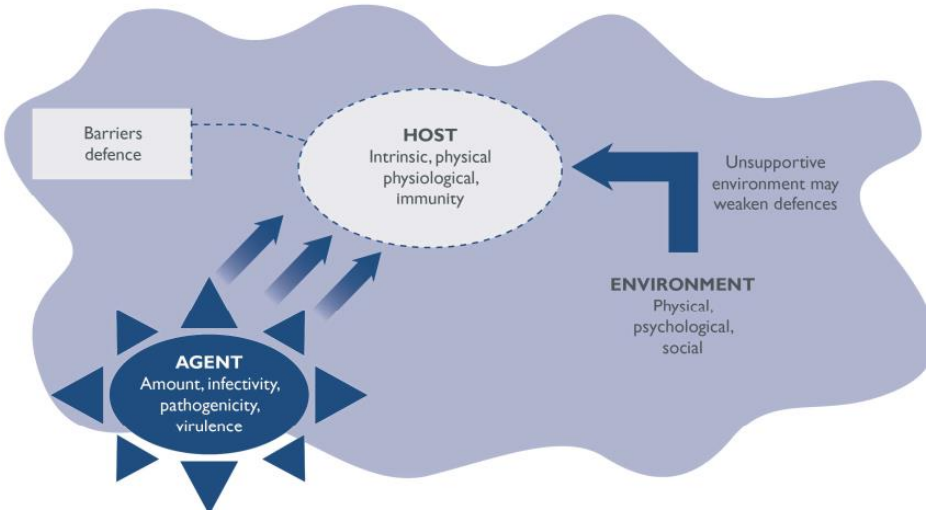


Sequential Techniques

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 accident (Leveson, 2004).

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.

Epidemiological Techniques

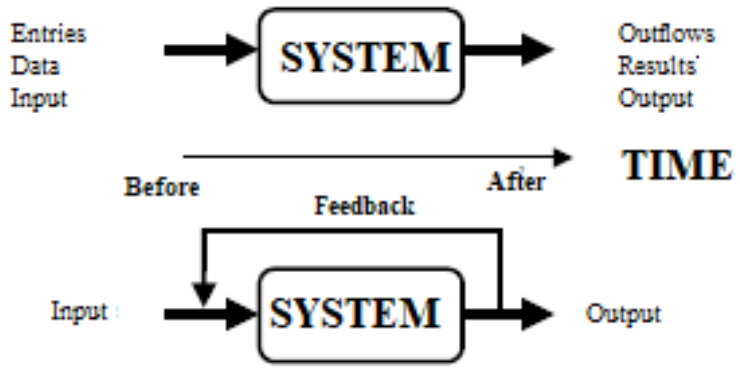


Epidemiological Techniques

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: OHS Body of Knowledge, Models of Causation: Safety

Systemic Techniques

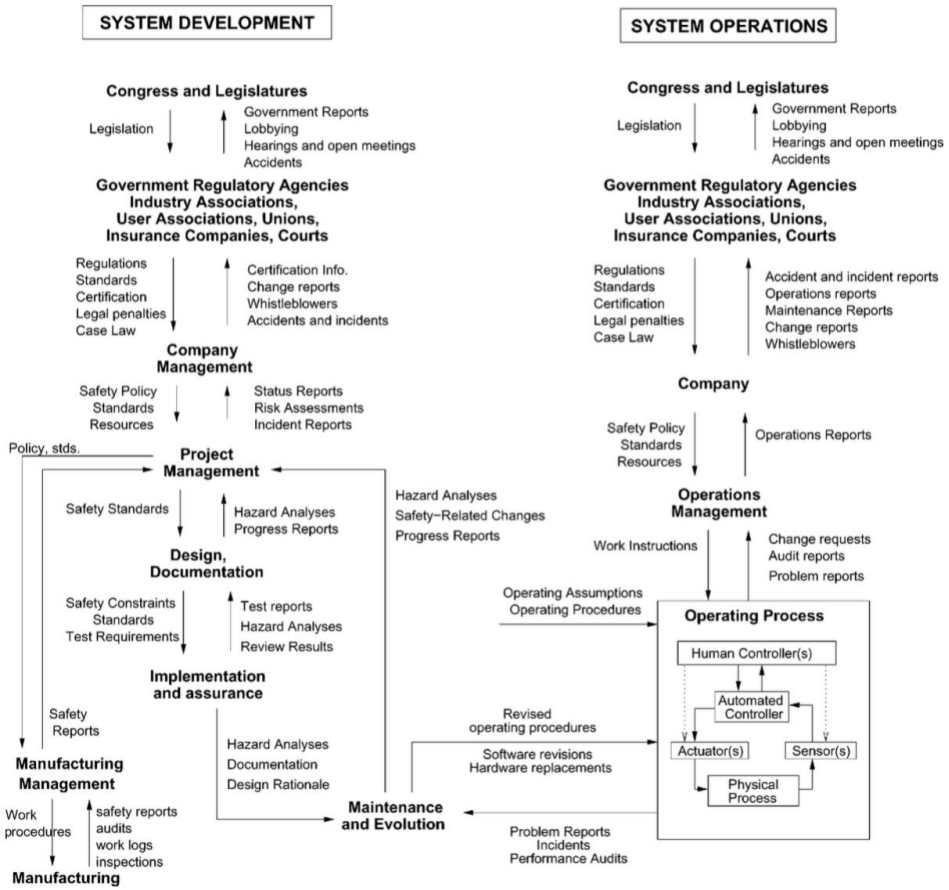


Systemic Techniques

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



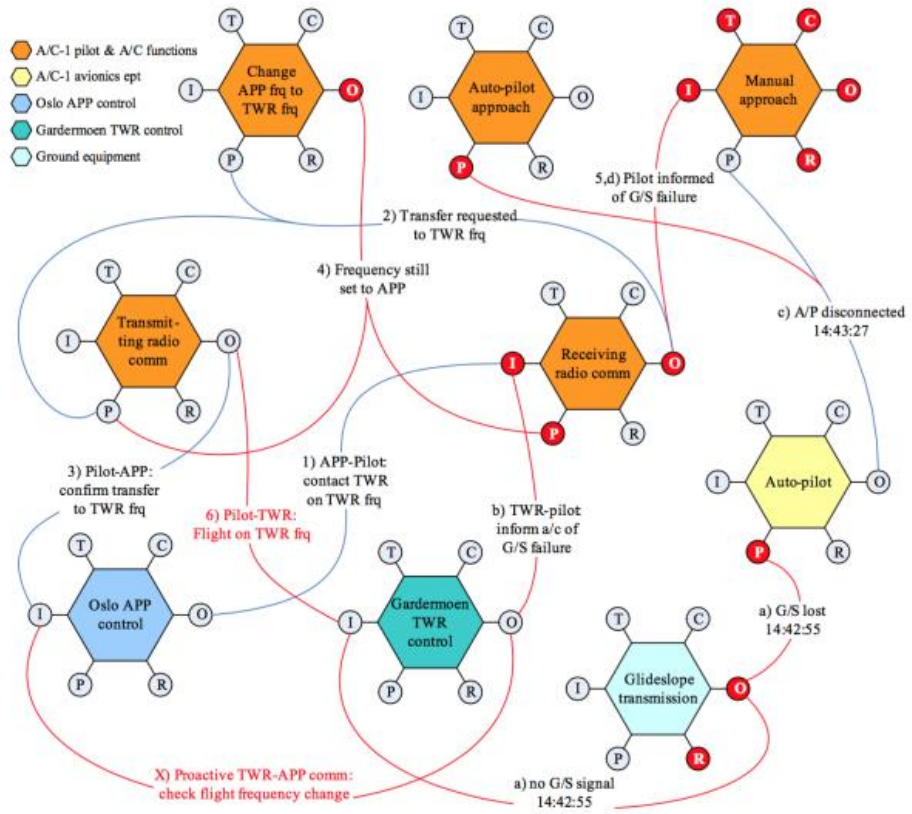
Systems-Theoretic Accident Model and Process (STAMP)

Leveson's model considered systems as "interrelated components that are kept in a state of dynamic equilibrium by feedback loops of information and control".

It emphasised that safety management systems were required to continuously control tasks and impose constraints to ensure system safety.

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



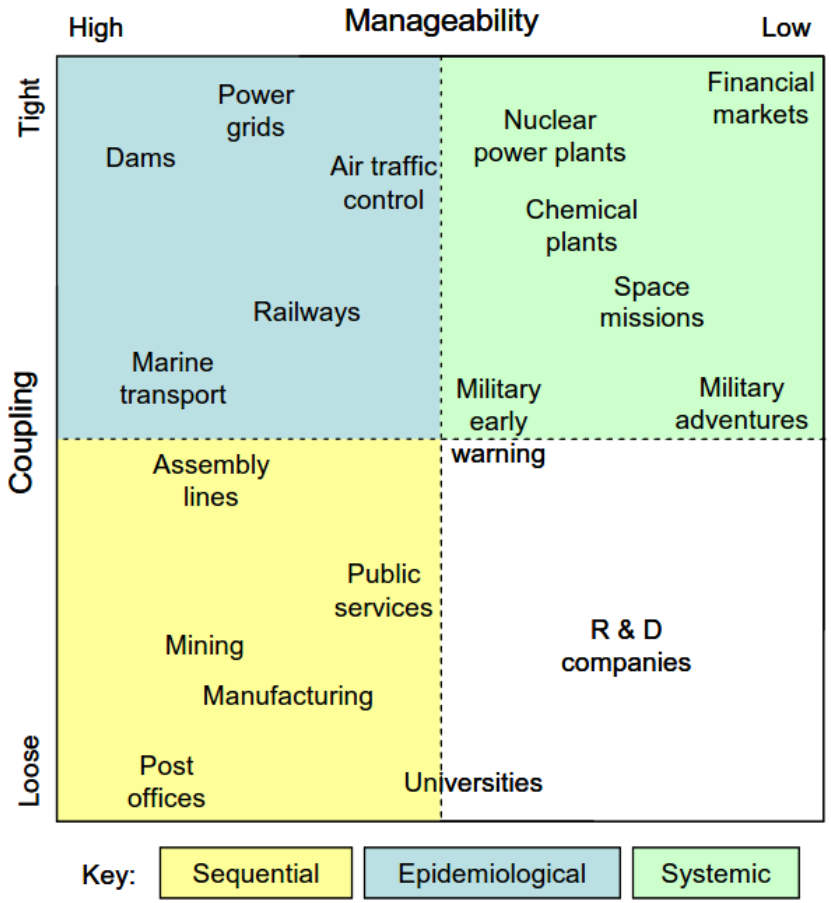
Functional Resonance Accident Model (FRAM)

A system interacts with its context through a collection of functions, that can be characterized by input, output, resources it needs, its control and real-time behavior.

Functions interact through these aspects. Please note that this is a functional view of systems that abstracts away from its internal components and concentrates on logical behavior. It is similar to the view of systems taken by structured analysis for real-time systems.

I. A. Herrera and R. Woltjer. “Comparing a multi-linear (STEP) and systemic (FRAM) method for accident analysis”. In: Reliability Engineering and System Safety 95.12 (2010), pp. 1269–1275. issn: 0951-8320.

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

Analysis technique suitability

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.researchgate.net/publication/259339662_Accident_Analysis_Models_and_Methods_Guidance_for_Safety_Professionals

Analysis technique suitability

Write report with recommendations

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

A report should include a description of the accident sequence, the facts and analysis, causal factors, and corrective actions. This professional document will be used not only for documentation, but also to prevent future accidents by initiating the corrective actions listed.

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

Analysis technique suitability

Accident reports should, at a minimum, contain:

Methodology.

Sequence of events (a thorough accident description).

Facts and analysis.

Causal factors.

Corrective actions.

Conclusions and summary.

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

Analysis technique suitability

Investigation procedure

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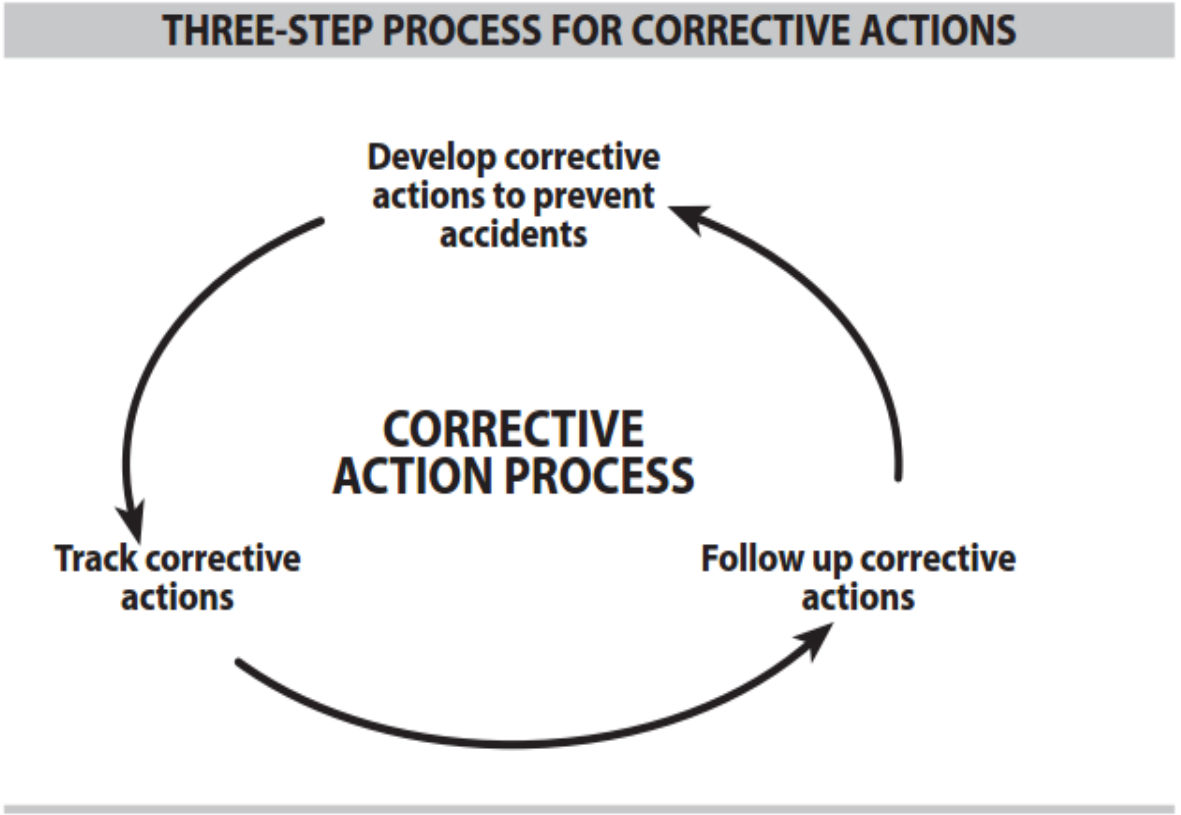
Analysis technique suitability

Follow-up



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

Analysis technique suitability

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

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Q&A

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