

Health, Safety & Environment (CDB 1012/CEB 1032)

TOPIC : ACCIDENT CAUSATIONS

Module 2.1 : DEFINITION, THEORIES AND THE PRICE TO PAY



Lecture Contents & Outcomes

- Understand
 - Accident & Incident
 - Why we need to learn how accident occur?
 - Accident Causation Theories - underlying messages contained in the different theories, the similarities and the differences
 - Cost of Accidents

What is an Accident?

An *unintended* or *unplanned* event.

Characterized by unacceptable consequences
e.g. *injury* to persons,
damage to assets.

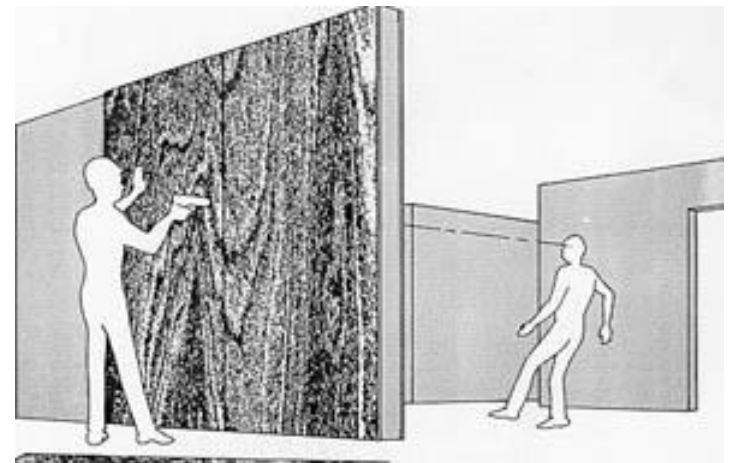
Any **unwanted event** that **causes harm** to people, property, or processes.



Incident is any observable human activity that is an **unwanted event** that **might have** had a negative impact on the people, property or process involved.

Example #1- Struck by a nail (source: www.osha.gov)

A carpenter apprentice was killed when he was struck in the head by a nail that was fired from a power actuated tool. The tool operator, while attempting to anchor a plywood form in preparation for pouring a concrete wall, fired the gun causing the nail to pass through the hollow wall. The nail traveled some twenty-seven feet before striking the victim. The tool operator had never received training in the proper use of the tool, and none of the employees in the area were wearing personal protective equipment.



Why do we need to know how an accidents happened?

- To prevent accidents we must know why they happened.
- To seek not only the immediate causes but also the prior conditions and underlying causes of accidents.
- The focus should be on “how could similar incidents/accidents be prevented”.

Nature Of Accidents

Each accidents must be looked at in terms of having two components:

THE EVENT

- It is the event that is to be prevented, because if the event does not take place there can be no consequences.
- There is also concern for “near misses” where there is no actual damage.

THE CONSEQUENCES

- The final loss resulted e.g. injury, death, disease, ill health, productivity/material damage.
- The consequences are not always immediately apparent.

Accident Causation Theories

Why care about “theories”?

- “The scientific approach is based on the principle that theory is the bridge between experiment and practice”
- Accident theories: Good accident theories can help identify the sources of problems, which can lead to targeted prevention efforts

Accident Causation Theories

- Think of accidents as **being caused**, rather than occurring by **chance** ...
- As such, we can break them apart, apply engineering techniques, identify the contributing factors, and prevent them from occurring again.

Accident Causation Theories

- Explain why accidents happen.

The purpose of these theories are:

1. **To provide a classification system:** logical, objective and universal system that aids analysis and control
2. **To assist in hazard identification:** logical framework for hazard identification
3. **To aid accident investigation and prevention:** ensure investigation is based on logical and reasoned arguments.

Accident Causation Theories

The most widely know Accident Causation Theories are the:

- Heinrich's Domino theory
- Human Error/Factors theory
- Accident/incident theory
- Systems theory
- Combination theory

Heinrich's Domino Theory

- Established by Herbert W. Heinrich in the 1920's
- One domino can fall and impact the others.
 - Social Environment →
 - Undesirable traits →
 - **Unsafe acts or conditions** →
 - An accident →
 - Injury



Heinrich's Domino Theory

Ancestry & social environment.

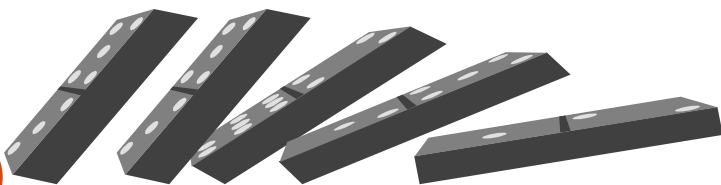
Negative character traits inherited (ancestry) or acquired as a result of the social environment.

Fault of person. Negative traits are the reason why people behave in unsafe manner and why hazardous conditions exist.

Unsafe act or condition Unsafe acts committed by people and mechanical or physical hazardous conditions are the direct causes of accidents.

Accident. Accidents that result in injury.

Injury. Typical injuries resulting from accidents include lacerations and fractures.



Heinrich's Domino Theory

- Heinrich: Of 75,000 accidents, 88% due to unsafe acts, 10% from unsafe conditions, and 2% unpreventable.
- Heinrich: Each 330 incidents, produce 300 with no injuries, 29 with minor injuries, and 1 with lost-time injury (LTI).
- Where should we focus our efforts, and how would we do that?

Unsafe Acts

- By-passing safety devices
- Failure to wear PPE
- Wearing unsafe clothing
- Failure to secure/to warn
- Unauthorised deviation from SOP
- Using defective or improper equipment
- Entering confined spaces without clearance
- Horseplay
- Working on equipment in operation
- Throwing materials/tools instead of carrying or passing them

Unsafe Conditions

- Defective tools and equipment
- Defective/incomplete design
- Ungrounded
- Un-insulated
- Improper or inadequate clothing
- Improper stacking or piling
- Inadequate space or clearance for moving objects
- Excessive noise
- Lack or poor of ventilation, lighting, illumination etc.

Heinrich's Domino Theory

Heinrich's theory has two central points:

- Injuries are caused by the action of **preceding factors**.
- Removal of the **central factor** (unsafe act/hazardous condition) denies the action of the preceding factors and, in so doing, prevents accidents and injuries.

Human Factors Theory

- The human factors theory of accident causation attributes accidents to a chain of events ultimately caused by **human error**.
- Human factors theory looks at the interaction between:
People-Tools/Technologies-Environment-Job-Organization
- And then looks to see where there are mismatches that might have led to accidents or could be fixed to prevent accidents

Human Error

- An inappropriate or undesirable human decision or behavior that reduces, or has the potential for reducing effectiveness, safety or system performance. (Sanders and McCormick, 1993)
- Those occasions in which a planned sequence of mental or physical activities fails to achieve its intended outcome, and when those failures cannot be attributed to chance. (Reason, 1990)

Who can make errors?

- operators, equipment designers, managers, supervisors, maintenance personnel, CEOs, you.....

Why do errors happen?

- Discrete-Action Classifications
 - errors of omission - failure to do
 - errors of commission - failure to do properly
 - sequence errors - failure to do in the correct order
 - timing errors - failure to do at a specific time or rate

Why do errors happen?

- All of us (generally)
 - have limitations in our ability to process information
 - have memory limitations
 - face various pressures to make decisions, and/or actions in a certain way because of policies, procedures, technology, management, etc.
 - have made decisions or acted on the basis of poor/wrong information

Human Factors Theory

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graph TD; A[Human Factors Theory] --> B[Overload]; A --> C[Inappropriate Response]; A --> D[Inappropriate Activities];
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Overload

- **Environmental Factors**
(noise, distractions)
- **Internal Factors**
(personal problems, emotional stress)
- **Situational Factors**
(unclear instructions, risk level)

Inappropriate Response

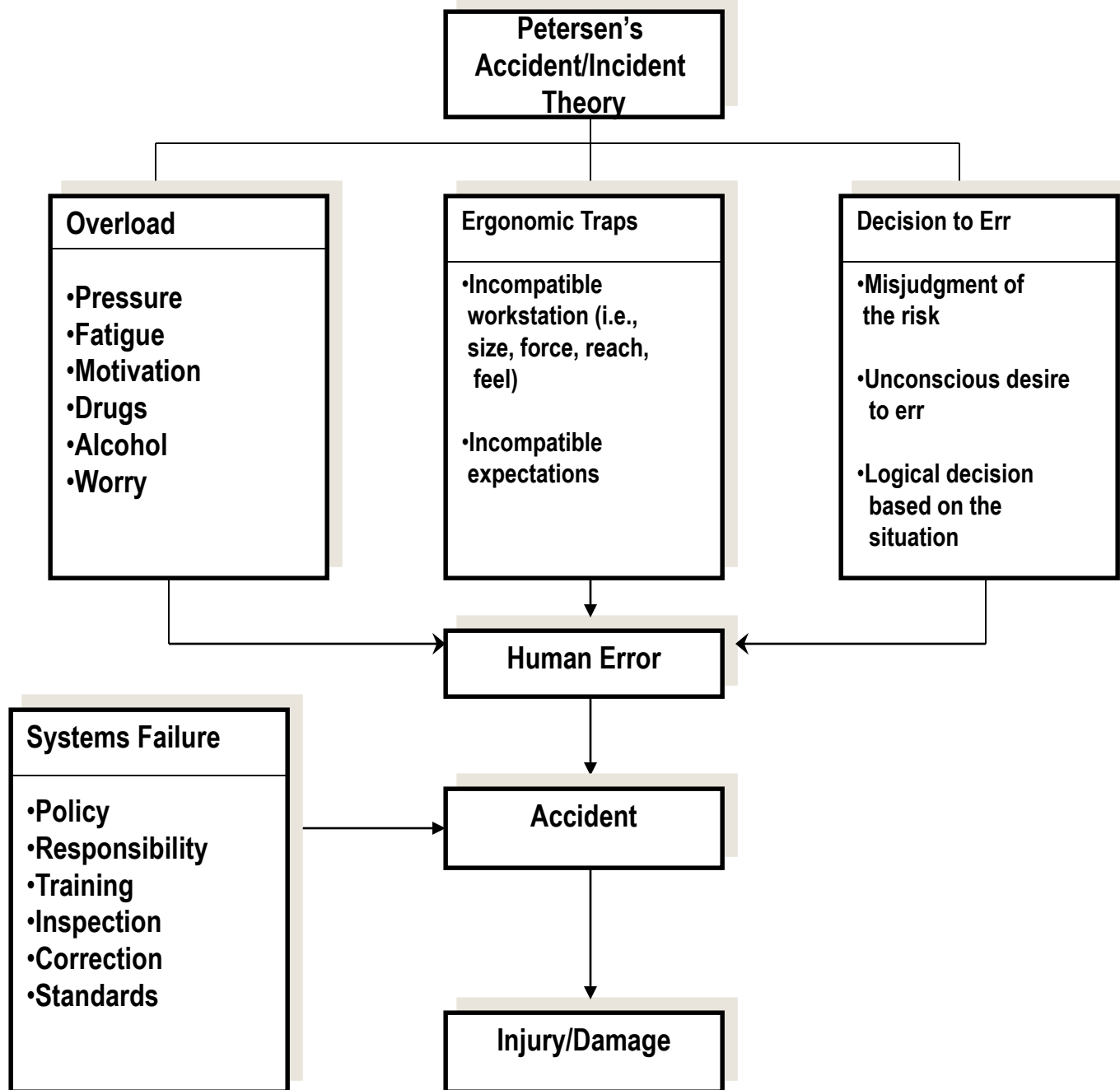
- **Detecting a hazard but not correcting it**
- **Removing safeguards from machine and equipment**
- **Ignoring safety**

Inappropriate Activities

- **Performing tasks without the requisite training**
- **Misjudging the degree of risk involved with a given task**

Accident/Incident Theory

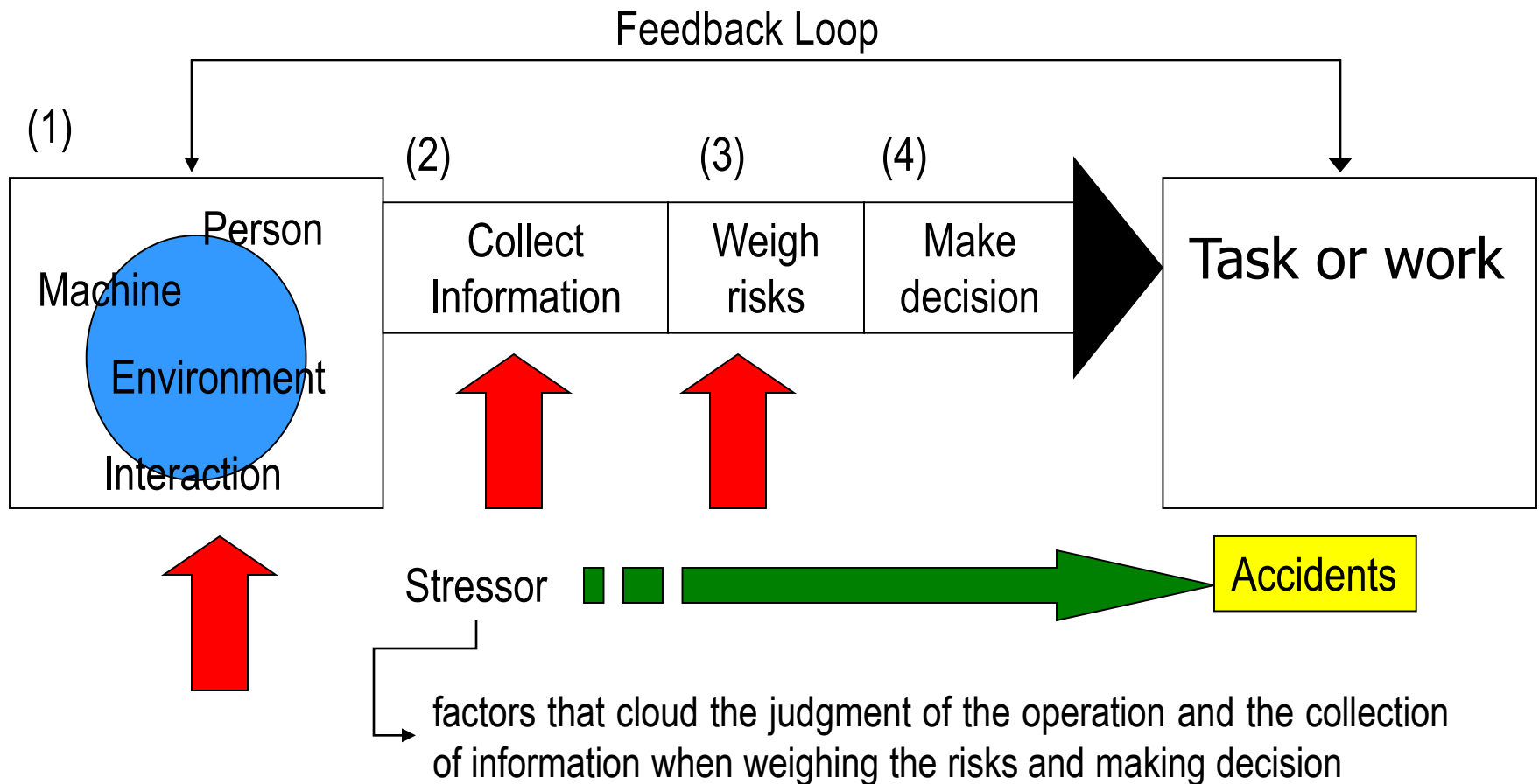
- An extension of the Human Factors Theory.
- Addition of **ergonomic traps** (e.g. uncomfortable workstation, incompatible expectations etc.) and **decision to err** (e.g. misjudgment of the risk, etc)
- Establishes the **(failure of)** role of management (management decisions/behavior) in accident causation.



Systems Theory

- The likelihood of an accident occurring depends on the interactions between **person (worker), machine and workplace environment**.
- Changes in these interactions can increase or decrease the likelihood of an accident occurring.
- E.g. change in the work schedule, noise, new machinery etc.

Systems Theory of Causation

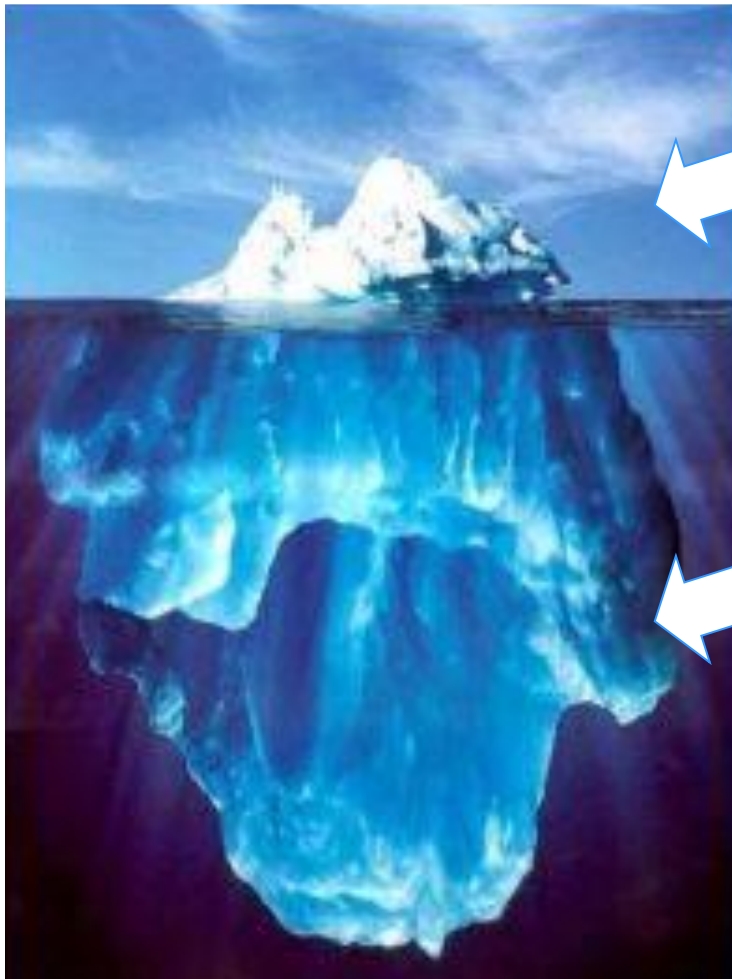


Combination Theory

- The actual cause may **combine parts of several different models**.
- Safety personnel should use these theories as appropriate both for accident prevention and accident investigation.
- However, they should avoid the tendency to try to apply one model to all accidents.
- “One Model Does Not Fit All”

Cost of Accident

ICEBERG MODEL for Costs of Accidents



Direct Costs

Immediate costs, easier to quantify, *just the tip of the iceberg!*

Indirect Costs

Hidden costs, hard to quantify, many times more than the direct costs.

Costs Of Accidents

Monetary Implications: injury, illness, death. Damage to property, material, equipment, or environment. Can include lost time, production, sales, reputation, customer base. Investigations, clean-up, litigation, restitution, etc....

Examples of Direct Costs

- Insurance claims
- Medical expenses
- Lost wages
- Disability benefits

Examples of Indirect Costs

- Time lost because of the accident
- Training costs for new/replacement workers
- Administrative costs

Summary

- Many theories, in part or in total, work in many situations.
- What is important is to understand the underlying messages contained in the different theories, the similarities and the differences.