

Industrial Health & Safety

Accident Prevention and Theories of Accident Causation



Accident Prevention

Industrial Place Accidents - Typical Year
Work related accidents cost \$48 Billion
7,100,000 injured workers per year
On average, 3 injured workers per 100 workers
One accidental death every 51 minutes
One serious injury every 19 seconds

To prevent accidents, need to know
why accidents happen and what causes them.

Accident Causation Theories are used as
models to help predict and prevent accidents. 2



Theories of Accident Causation

Domino Theory
Human Factors Theory
Accident / Incident Theory
Epidemiological Theory
Systems Theory
Combination Theory

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Domino Theory

Herbert Heinrich - Travelers Insurance - 1920's

Two Central Points

Injuries are caused by the actions of preceding
factors.

Removal of the central factor (unsafe act or
hazardous condition) negates the action of the
preceding factors; and in doing so, prevents
accidents and injuries.

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Heinrich's Axioms of Industrial Safety

1. Injuries result from a series of preceding factors.
2. Accidents occur as the result of physical hazard or an unsafe act.
3. Most accidents are the result of unsafe behavior.
4. Unsafe acts and hazards do not always result in immediate accidents and injuries.
5. Understanding why people commit unsafe acts helps to establish guidelines for corrective actions.

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Heinrich's Axioms of Industrial Safety

6. The severity of the injury is largely fortuitous and the accident that caused it is preventable.
7. Best accident prevention techniques are analogous to best quality / productivity techniques.
8. Management should assume safety responsibilities.
9. The supervisor is the key person in the prevention of industrial accidents.
10. Cost of accidents include both direct costs and indirect costs.



Human Factors Theory

Attributes accidents to a chain of events that were ultimately the result of human error.

Three broad factors leading to human error

- Overload
- Inappropriate Responses
- Inappropriate Activities

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Overload

Worker's Capacity -

- Natural Ability, Training, State of Mind,
- Fatigue, Stress, Physical Condition

Environmental Factors -

- Noise, Climatic, Lighting, Distractions, etc

Internal Factors -

- Personal Problems, Emotional Stress, Worry

Situational Factors -

- Level of Risk, Unclear Instructions, Novelty, etc



Inappropriate Responses

Ignores a suspected hazard

Disregards established safety procedures

Circumvents safety devices

Includes incompatibility with person's workstation
Size, Required Force, Reach, Feel, etc

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Inappropriate Activities

Performing tasks without requisite training

Misjudging the degree of risk

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Accident/Incident Theory

Petersen's Extension to the Human Factors Theory

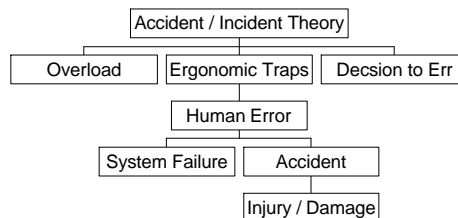
Adds new elements -

- Ergonomic Traps
- Decision to Err
- System Failures

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Petersen's



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Overload

- Pressures
 - Deadlines, Budget Factors, Peer Pressure
- Fatigue
- Motivation
- Drugs
- Alcohol
- Worry

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Ergonomic Traps

- Incompatible Workstation
- Incompatible Expectations

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Decision to Err

- Misjudgment of Risks
- Unconscious Desire to Err
- Logical Decision Based on Situation / Circumstances
- Superman Syndrome (It won't happen to me!)
 - Bulletproof, Invincible, Immortal, Lucky

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System Failures

- Potential for causal relationship between managerial decisions/behaviors regarding safety
- Policies
- Responsibilities
- Training
- Inspections
- Corrective Actions
- Standards

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Epidemiological Theory

- Traditional approaches focused on accidents and resulting injuries.
- Current trend includes a broader perspective of *industrial hygiene issues*.
- Industrial Hygiene concerns environmental issues that can lead to sickness, disease, impaired health.

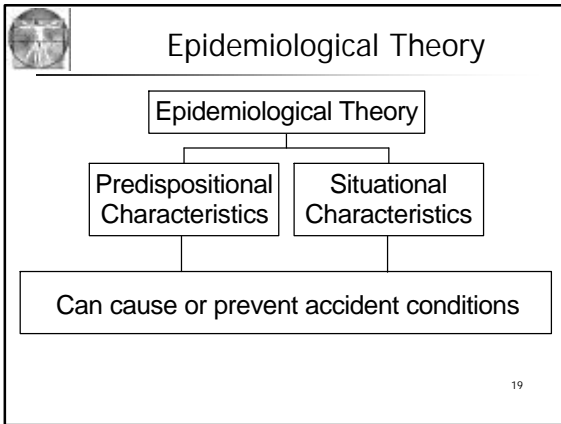
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Epidemiological Models

- Used to study causal relationships between environmental factors and disease.
- Theory supposes these models are also appropriate for studying the casual relationships between environmental factors and accidents.
- Note: Causal NOT Correlational Relationships !!!

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Systems Theory of Causation

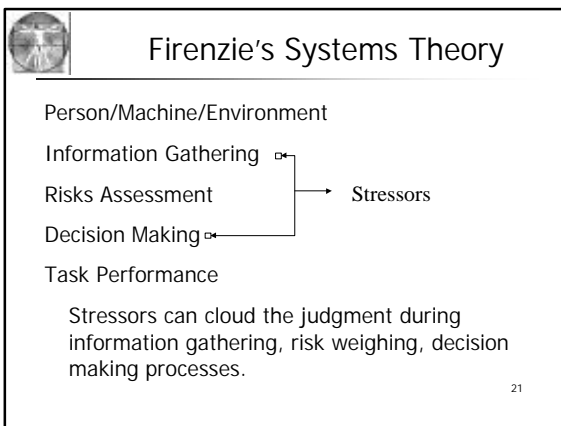
System is a group of interacting and interrelated components that form a unified whole.

Host (People) Agent (Machinery) Environment

The likelihood of an accident occurring is determined by how these components interact.

Changes in the patterns of interaction can increase or decrease the probability of an accident occurring.

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Firenze's Recommendations

Consider Five Factors -

- before beginning the process of information gathering, risk weighing, decision making.
- Job Requirements
- Worker's Abilities and Limitations
- Gain from Successful Task Completion
- Loss if Task Attempted but Results in Failure
- Loss if Task is Not Attempted

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Combination Theory of Causation

Theories and models are not necessarily reality.

A single theory may not suit all circumstances.

Some theories address particular problems better than other theories.

A combination of theories and models may be the optimal approach toward problem solutions.

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