Investigating and Analysing Human and Organizational Factors

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Outline

- Meaning of Human Factors
- Collecting Data
- Meaning of Human Error
- Investigating and Analysing
- Understanding Socio-technical Systems
- Using Accident Models

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Meaning of Human Factors

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Meaning of Human Factors

- What do we mean by "Human Factors"?
  - It isn't just about human limits…
  - It is about optimizing human-technology interactions in complex environments to achieve the goals of safety and efficiency…
  - "Human Factors is concerned to optimize the relationship between people and their activities, by the systematic application of human sciences, integrated within the framework of systems engineering."   (ICAO Digest No. 1)

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A Short History Lesson...

Focus on Technology (Design)

Focus on People (Training)

Focus on the System (Resilience)

1950s   1970s   1990s

Time

Collecting Data

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A Conceptual Model of Human Factors
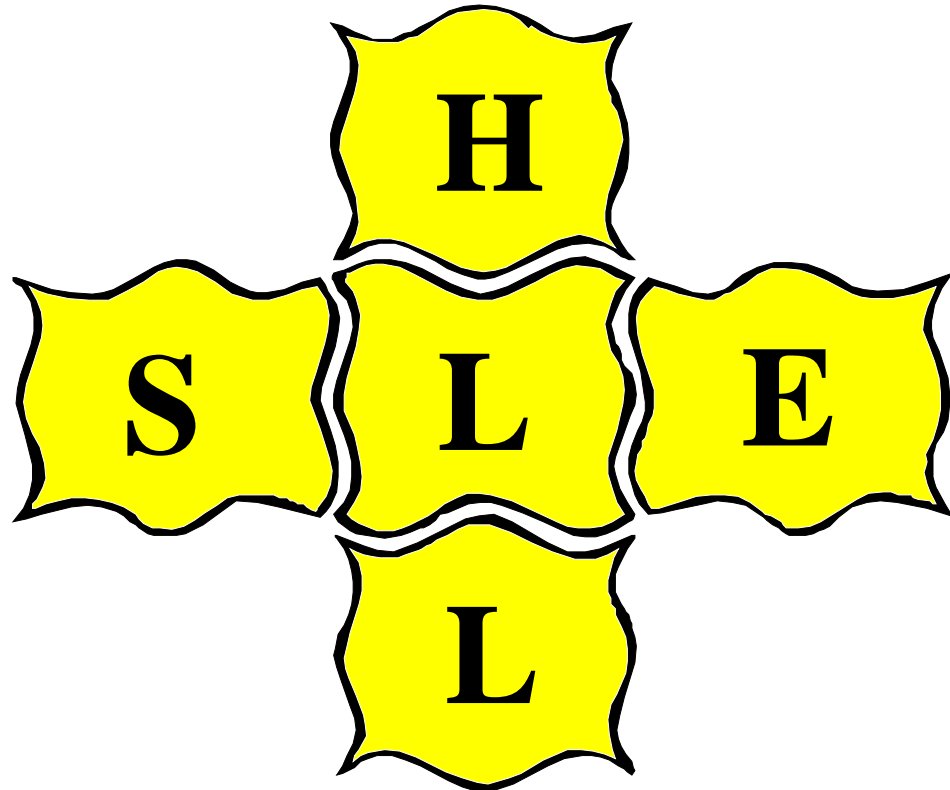
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Meaning of Human Error

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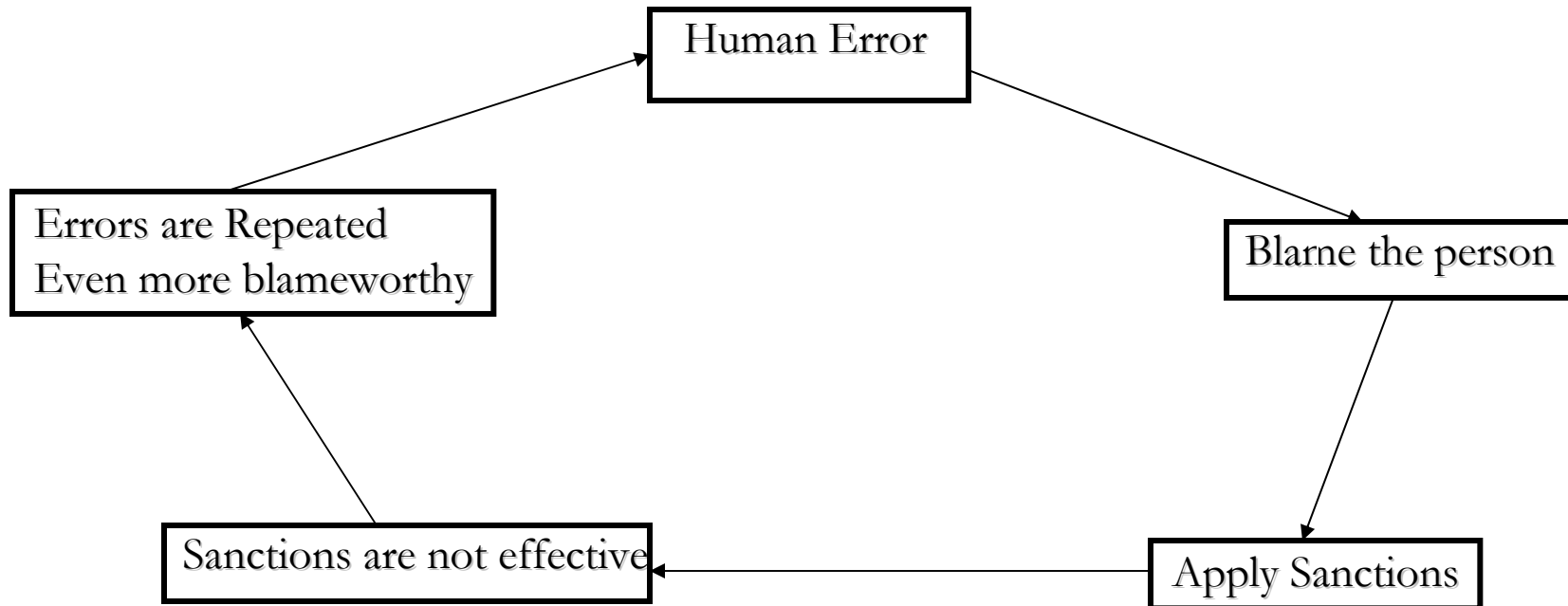Canada

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Human Error

- ## Old View:
  - – Human error is a cause of trouble
  - – To explain failure, must seek failure
  - – You must find people's inaccurate assessments, wrong decisions and bad judgments

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The Blame Cycle*

Human Error

Blame the person

Apply Sanctions

Sanctions are not effective

Errors are Repeated
Even more blameworthy

*Adapted from Reason, J., Managing the Risks of Organizational Accidents

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Human Error

Old View

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Human Error

- ## New View:

  - Human Error is a symptom of trouble deeper inside a system

  - To explain failure, do not try to find where people went wrong

  - Instead, find out how people's assessments and actions made sense a the time given the circumstances that surrounded them
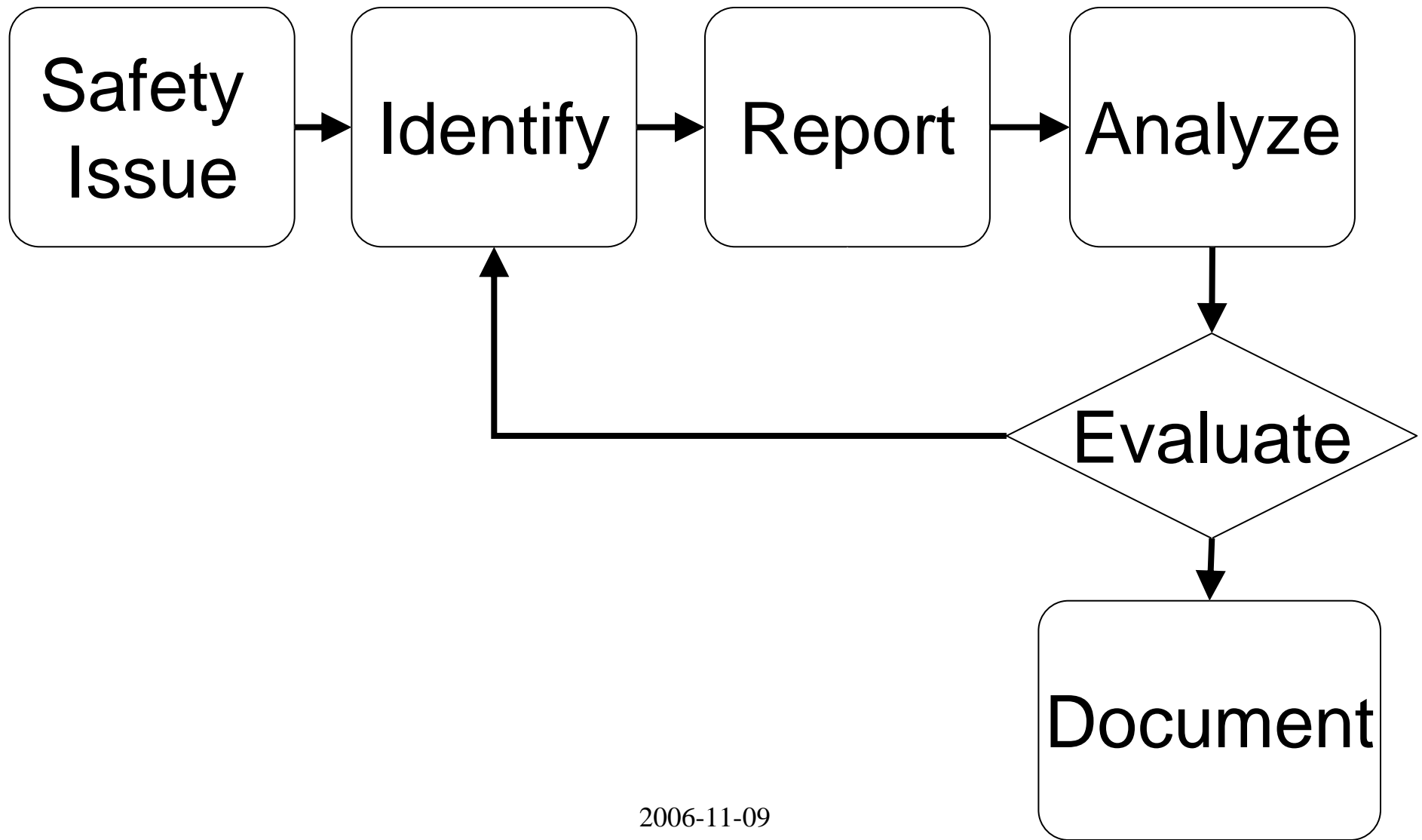
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Human Error

New View

Investigating and Analysing

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Basic Safety Management Process

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┌──────────┐      ┌──────────┐      ┌──────────┐      ┌──────────┐
│  Safety  │ ──►  │ Identify │ ──►  │  Report  │ ──►  │ Analyze  │
│  Issue   │      │          │      │          │      │          │
└──────────┘      └──────────┘      └──────────┘      └──────────┘
                       ▲                                    │
                       │                                    ▼
                       │                              ◇ Evaluate ◇
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Aims of Human Factors Investigation

- Discover how human performance could have caused or contributed to the occurrence

- Identify conditions that influenced human performance (decisions, actions)

- Make recommendations designed to eliminate or reduce these conditions or the consequences of human error

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What were they thinking???

"The reconstruction of the mindset begins not with the mind. It begins with the circumstances in which the mind found itself."

Dekker (2002)

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Human Factors Event Analysis Process

1. Lay out sequence of events
    *   Go back far enough to study the underlying factors

2. Break sequence into 'episodes' of critical events and identify information available to people in each episode

3. Reconstruct the unfolding situation from the mindset of those in the situation
    *   Why did their actions make sense to them at the time?
    *   To what cues were they attending?
    *   What situational conditions were influencing them at the time?

4. Relate episode descriptions to human factors principles

5. Test that there are valid links between the behaviours described in the episodes and the identified principles

Dekker (2006)

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Understanding
Socio-technical Systems

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Organizations and Socio-technical Systems

- Socio-technical systems:
  - Socio: Humans
  - Technical: Technology
  - System: Composition of regularly interacting groups of activities which, when taken together, form a new whole
    - This whole has properties which cannot be found in the constituent elements.

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Organizations and Socio-technical Systems

- Safety is an emergent property
  - Accidents have contributing factors at multiple levels in an organization

- Work practices are dynamic
  - Gradual migration at multiple levels over time
  - Difficult to see interactions across levels

- Threats caused by lack of vertical integration
  - Instructions don't propagate downwards
  - Feedback doesn't propagate upwards
  - Conflicting objectives and priorities

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Accident Causation Models to Guide Investigation and Analysis

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Accident Causation Models

- Select and organize data
- Guide investigation and analysis
- Three basic types of models
  - Sequential
  - Organizational
  - Systemic

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Sequential Models

- Natural, almost intuitive approach to accident investigation

- Cause and effect

- Repeatedly ask "why did this happen?"

- Allows investigation to dig deep, into specific, separate areas

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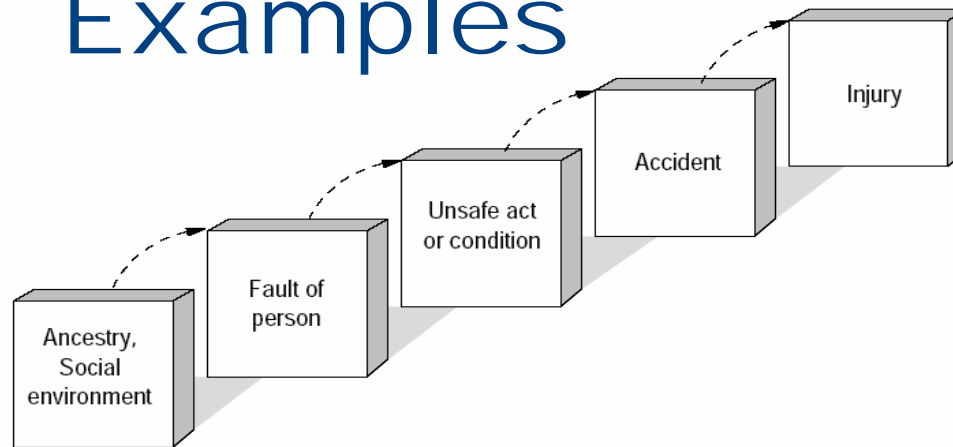
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Examples

- Domino

Figure 2.1: Heinrich's Domino Model of Accidents.

- Root Cause Analysis
  - A way of solving problems by looking at cause and effect relationships
  - An analytical attempt to identify the cause or causes that should be mitigated to prevent recurrence

Sequential Models

- ## Strengths:
  - Intuitive
  - Simple
  - Follows the causes deep into an organization

- ## Weaknesses:
  - "Root cause" is an arbitrary stopping point
  - Does not allow you to find relationships and conditions in a system
  - Difficult to find cause and effect relationships when things are separated by time and place

Organizational Model
(Epidemiological)

- View accidents as a result of a combination of factors
  - Active Failures (performance deviations)
  - Environmental conditions
  - Barriers
  - Latent conditions (management factors)
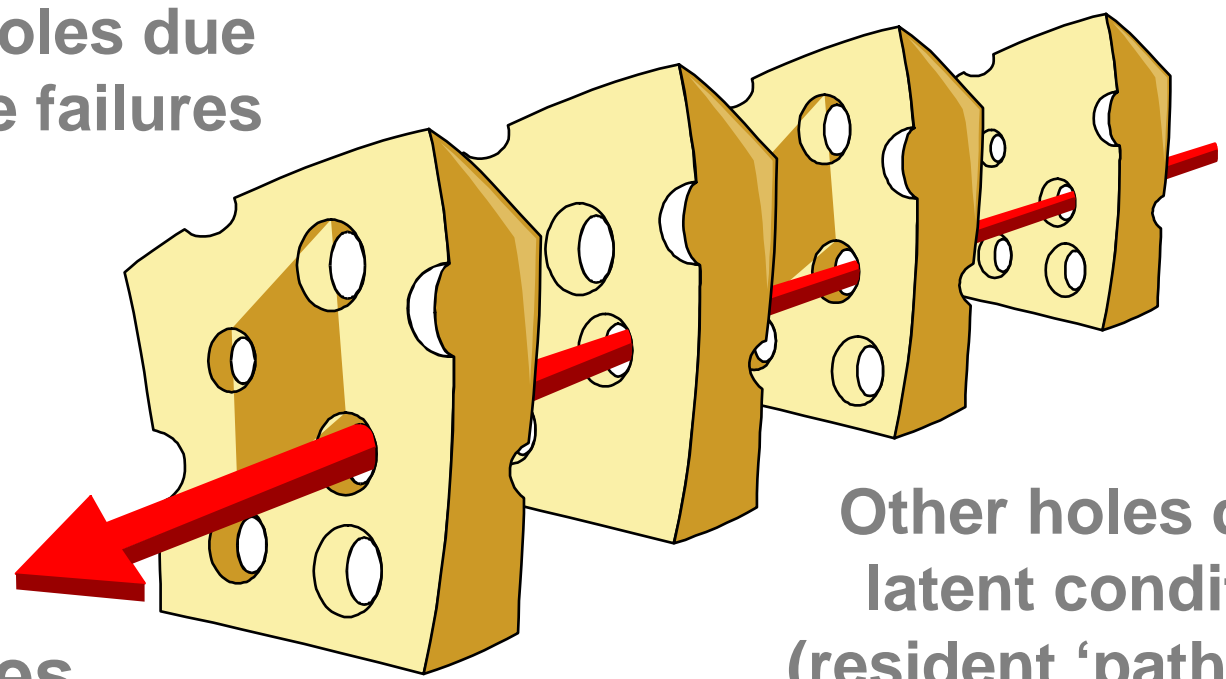- Reason's model is the most well known example of this approach

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Reason's (Swiss Cheese) Model of Accident Causation

Some holes due to active failures

Hazards

Other holes due to latent conditions (resident 'pathogens')

Losses

Successive layers of defences, barriers, & safeguards

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Organizational Models

- ## Strengths:
  - Able to reflect the complexity of most accidents
  - Notion of latent factors forces an examination beyond cause and effect

- ## Weaknesses:
  - Presents a static model of the organization
  - Is descriptive, not predictive
  - Defenses-in-depth approach can contribute to accidents by increasing complexity
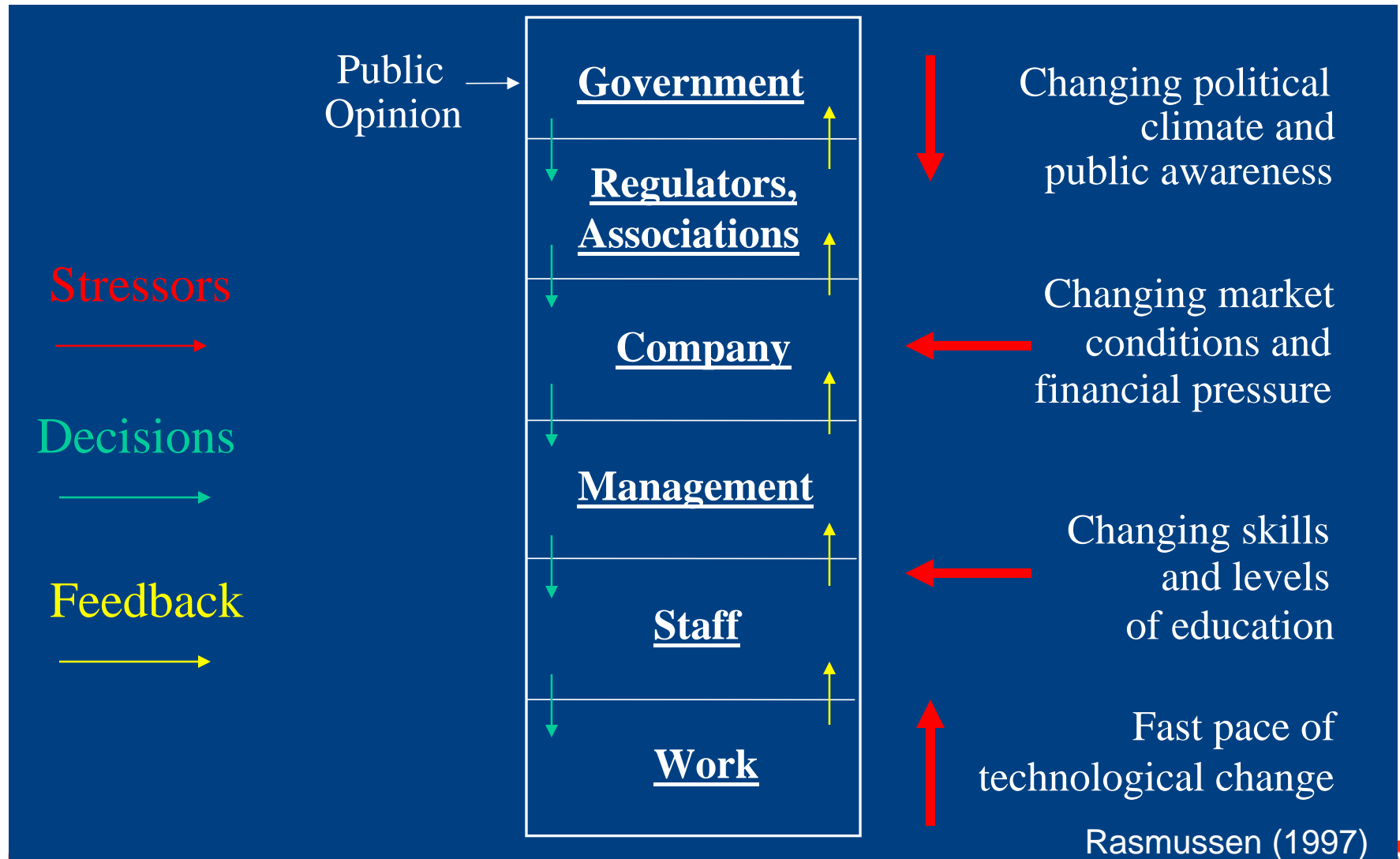
Systemic Model

- This model looks at the performance of the system as a whole
- Accidents are viewed an emergent phenomena of the system (as is successful performance)
  – Accidents result from normal work situations
- Structural hierarchy is modeled
- Migration or drift is modeled

Structural Hierarchy of Actors

Public
Opinion → **Government**   Changing political
                                        climate and
                                        public awareness

          **Regulators,
          Associations**

Stressors   Changing market
                                        conditions and
→   **Company**   ←   financial pressure

Decisions

→   **Management**

                                        Changing skills
                                        and levels
Feedback   ←   of education
→   **Staff**

                                        Fast pace of
          Work   ↑   technological change

Rasmussen (1997)

Systemic Models

- ## Strengths:
  - Closest representation of real world
  - Dynamic look at the system that produced the occurrence
  - Able to look at complex webs of relationships and interactions

- ## Weaknesses:
  - Time and resource intensive
  - Complex methods
  - Lengthy explanations

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Bottom Line on Accident Models...

- As with all safety management processes, there are many approaches to investigation and analysis of Human Factors issues

- My goal today was to provide you with some practical steps (first part of the presentation)

- And some new information to help you select the good approaches for your organization (second part of the presentation)

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A few extra points...

Human Factors for Analysts, Investigators and Evaluators

- Hindsight bias
- Counterfactual reasoning bias
- Judgment bias
- Proximal bias

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Summary

- Meaning of Human Factors (ICAO)
- Collecting Data
- Meaning of Human Error
- Investigating and Analysing
- Understanding Socio-technical Systems
- Using Accident Models

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How does Human Factors relate to other safety disciplines?

Human Factors and System Safety

System Safety	Human Factors
Goal: To eliminate or control hazards	**Goal:** Optimize system performance (Human-tech)
General Methods: Hazard analysis, risk management, reliability engineering, design and testing (safety), sequential models, human error, human reliability…	**General Methods:** Human sciences, systems engineering, design and testing (Human-tech), organizational and systemic models, human performance, task analysis, work analysis…

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Human Factors and Risk Management

Risk Management	Human Factors in RM
1. Initiate the Process	1. HF data and methods
2. Preliminary Analysis and Estimate the Risk	2. Human-tech issues using HF methods
3. Evaluating the Risk Activity	3. Appropriate risk component values
4. Control the Risk	4. Underlying factors
5. Take Action	5. HF methods
6. Monitor Impact/Follow-up	6. Appropriate monitoring (time and value) and appropriate language

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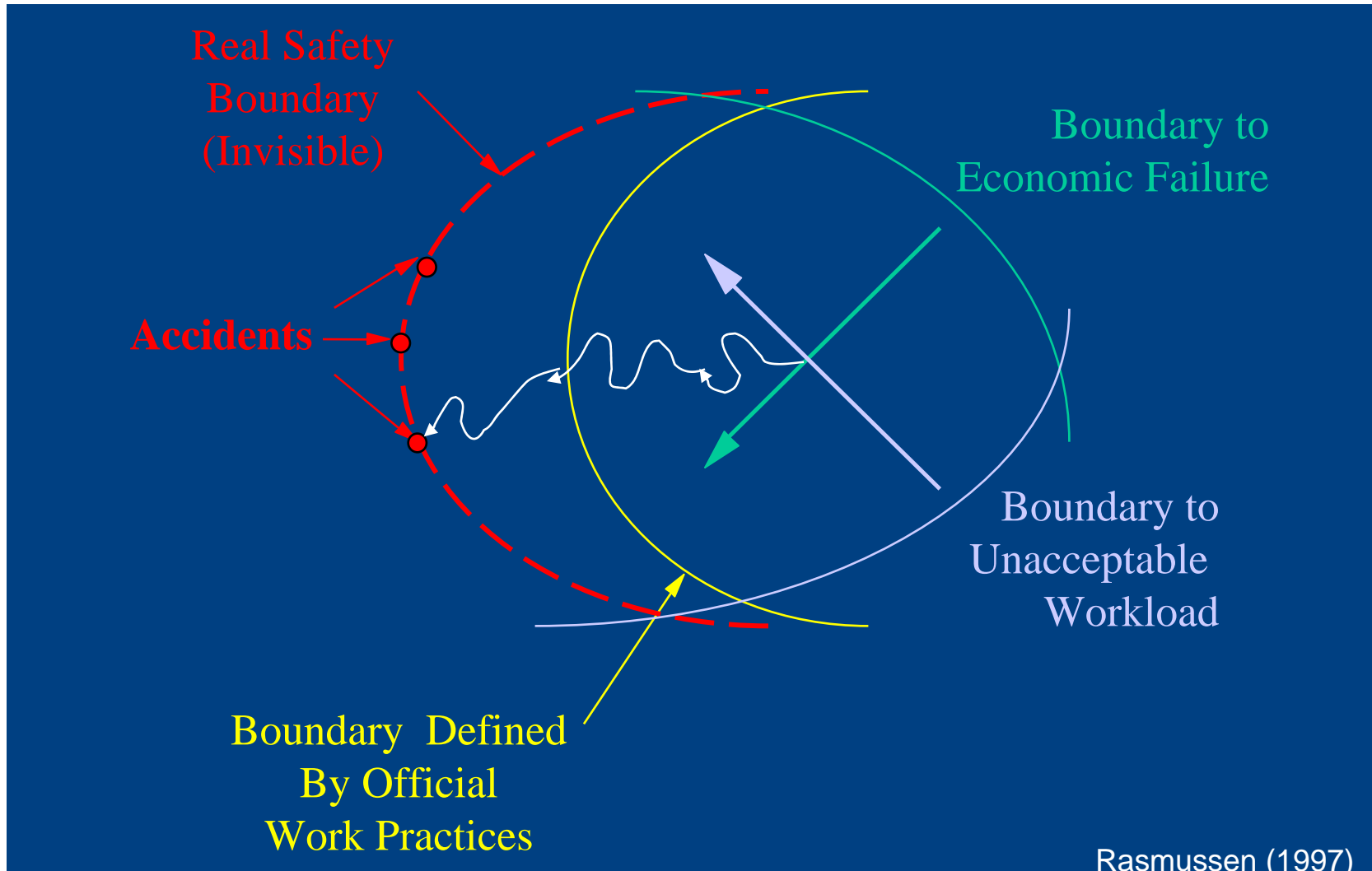# Human Factors and Safety Management Systems (SMS)

SMS	Human Factors in SMS
1. Safety Management Plan	1. Sociological and Engineering HF research
2. Documentation	2. User-centered design
3. Safety Oversight (all components)	3. Reporting, investigation, analysis, corrective action, etc.
4. Training	4. User-centered design
5. Quality Assurance	5. Engineering HF research
6. Emergency Preparedness	6. Occupational safety and health

Dynamics

Rasmussen (1997)