Outline

• Meaning of Human Factors
• Collecting Data
• Meaning of Human Error
• Investigating and Analysing
• Using Accident Models
Meaning of Human Factors
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)
A Short History Lesson…

1950s
Focus on Technology (Design)

1970s
Focus on People (Training)

1990s
Focus on the System (Resilience)

Time
Collecting Data
A Conceptual Model of Human Factors

RDIMS 2124053
Meaning of Human Error
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
The Blame Cycle*

- Human Error
  - Errors are Repeated
    - Even more blameworthy
  - Sanctions are not effective
  - Blame the person
  - Apply Sanctions

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

Human Error
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 at the time given the circumstances that surrounded them
New View

Human Error
Investigating and Analysing
Basic Safety Management Process

Safety Issue → Identify → Report → Analyze

Evaluate → Document
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
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)
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)
Accident Causation Models to Guide Investigation and Analysis
Accident Causation Models

• Select and organize data
• Guide investigation and analysis
• Three basic types of models
  – Sequential
  – Organizational
  – Systemic
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
Examples

- Domino

- 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
Some holes due to active failures

Other holes due to latent conditions (resident ‘pathogens’)

Successive layers of defences, barriers, & safeguards

Reason’s (Swiss Cheese) Model of Accident Causation
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 as 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

Rasmussen (1997)

- **Government**
  - **Regulators, Associations**
  - **Company**
  - **Management**
  - **Staff**
  - **Work**

Stressors

- Public Opinion
- Decisions
- Feedback

*Changing political climate and public awareness*
*Changing market conditions and financial pressure*
*Changing skills and levels of education*
*Fast pace of 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
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)
A few extra points...
Human Factors for Analysts, Investigators and Evaluators

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

• Meaning of Human Factors (ICAO)
• Collecting Data
• Meaning of Human Error
• Investigating and Analysing
• Using Accident Models
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How does Human Factors relate to other safety disciplines?
# Human Factors and System Safety

<table>
<thead>
<tr>
<th><strong>System Safety</strong></th>
<th><strong>Human Factors</strong></th>
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<tbody>
<tr>
<td><strong>Goal:</strong> To eliminate or control hazards</td>
<td><strong>Goal:</strong> Optimize system performance (Human-tech)</td>
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<tr>
<td><strong>General Methods:</strong> Hazard analysis, risk management, reliability engineering, design and testing (safety), sequential models, human error, human reliability…</td>
<td><strong>General Methods:</strong> Human sciences, systems engineering, design and testing (Human-tech), organizational and systemic models, human performance, task analysis, work analysis…</td>
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<tr>
<td>Human Factors and Risk Management</td>
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<tr>
<td><strong>Risk Management</strong></td>
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<tr>
<td>1. Initiate the Process</td>
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<td>2. Preliminary Analysis and Estimate the Risk</td>
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<td>3. Evaluating the Risk Activity</td>
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<td>4. Control the Risk</td>
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<td>5. Take Action</td>
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<td>6. Monitor Impact/Follow-up</td>
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<td><strong>Human Factors in RM</strong></td>
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<tr>
<td>1. HF data and methods</td>
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<td>2. Human-tech issues using HF methods</td>
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<td>3. Appropriate risk component values</td>
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<td>4. Underlying factors</td>
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<td>5. HF methods</td>
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<tr>
<td>6. Appropriate monitoring (time and value) and appropriate language</td>
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# Human Factors and Safety Management Systems (SMS)

<table>
<thead>
<tr>
<th>SMS</th>
<th>Human Factors in SMS</th>
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<tbody>
<tr>
<td>2. Documentation</td>
<td>2. User-centered design</td>
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<tr>
<td>3. Safety Oversight (all components)</td>
<td>3. Reporting, investigation, analysis, corrective action, etc.</td>
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<tr>
<td>4. Training</td>
<td>4. User-centered design</td>
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<tr>
<td>5. Quality Assurance</td>
<td>5. Engineering HF research</td>
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Dynamics

Real Safety Boundary (Invisible)

Accidents

Boundary Defined By Official Work Practices

Boundary to Economic Failure

Boundary to Unacceptable Workload

Rasmussen (1997)