and organisational
Human Factors in Incident Investigation – practical tools & techniques

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Agenda

• Common shortcomings in oil & gas industry incident investigations
• Development & application of Human Factors Analysis Tools
• The importance of interview skills
• Relationship to improving safety, and other aspects of performance?
• An oil & gas industry case study
• Alignment with “just and fair culture”
• Questions & discussion
• Further reading & resources

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What do we mean by ‘human factors’ in hazardous industries?

and organisational

UK HSE “top-ten” human factors issues

- Managing human failure
- Procedures
- Training and competence
- Staffing, including supervision
- Organisational change
- Safety-critical communication
- Human factors in design
- Fatigue & shiftwork
- Organisational (safety) culture
- Maintenance, inspection and testing

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### GOAL: Managing human reliability & failure

#### Influences on human reliability & performance

<table>
<thead>
<tr>
<th>Influence</th>
<th>Factor</th>
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</thead>
<tbody>
<tr>
<td>Organisational (safety) culture</td>
<td></td>
</tr>
<tr>
<td>Usable procedures</td>
<td>Safety-critical communication</td>
</tr>
<tr>
<td>Training and competence</td>
<td>Human factors in design</td>
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<tr>
<td>Staffing levels, including supervision</td>
<td>Fatigue &amp; shiftwork</td>
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<td>Organisational change</td>
<td>Maintenance, inspection and testing</td>
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Background

• Major oil and gas company

• Good quality technical analysis, poor on behaviour / cultural aspects

• Tended to focus on blame, and assume all unsafe acts are intentional

• Desire to improve
Human Factors Analysis Tools

Identify Critical Factors & Causes; Write recommendations

Gather Evidence → Assemble Timeline

CF 1 → CF 2 → CF 3

Traditional analysis

Human factors analysis: intentional or unintentional?

ABC Analysis

Human Error Analysis

Specify behaviour(s) to be understood

Intentional Unintentional
Human Factors Analysis Tools

1. Gather Evidence
2. Assemble Timeline
3. Identify Critical Factors & Causes; Write recommendations

- CF 1
- CF 2
- CF 3

Traditional analysis

Human factors analysis

Specify behaviour(s) to be understood

Intentional

Behaviour intentional or unintentional?

Unintentional

ABC Analysis

Human Error Analysis

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Human error analysis

Oil and gas industry case study
HFAT analysis of five isolation incidents

- Three human errors, two violations of the control of work / isolation procedures.
- One incident involved a very experienced electrical technician – a classic maintenance error.
- The investigations identified a number of performance-shaping factors, which increased the likelihood of errors.
- Control of work system was analysed to establish if it was “error-tolerant”.
Human Factors Analysis Tools

Gather Evidence → Assemble Timeline → Identify Critical Factors & Causes; Write recommendations

Traditional analysis

Human factors analysis

Specify behaviour(s) to be understood

Intentional

Behaviour intentional or unintentional?

Unintentional

ABC Analysis → Human Error Analysis

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How people process information

1. **Perceive**
   - information from outside world

2. **Memory**
   - of training, procedures, recent events, etc

3. **Make decision**
   - based on perceptions and information from memory

4. **Take action**
   - based on decision

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## Organisational Performance Shaping Factors

<table>
<thead>
<tr>
<th>Type of Factor</th>
<th>Example</th>
<th>Your Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>The task</td>
<td>Workload – rushing to finish a job</td>
<td></td>
</tr>
<tr>
<td>Communications</td>
<td>Poor handwriting</td>
<td></td>
</tr>
<tr>
<td>Procedures &amp; documentation</td>
<td>Ambiguous wording</td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td>High background noise</td>
<td></td>
</tr>
<tr>
<td>Training &amp; experience</td>
<td>New start</td>
<td></td>
</tr>
<tr>
<td>Human-Machine Interaction</td>
<td>Alarm flood</td>
<td></td>
</tr>
<tr>
<td>Personal</td>
<td>Recent bereavement</td>
<td></td>
</tr>
<tr>
<td>Social &amp; team</td>
<td>Personality clash</td>
<td></td>
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</table>
Human reliability assessment
- a proactive technique for critical tasks -

<table>
<thead>
<tr>
<th>Task</th>
<th>Probability of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task of similar nature to process isolation, with some independent checking of output</td>
<td>?? in 1000</td>
</tr>
<tr>
<td>Above, without independent checking of output</td>
<td>?? in 1000</td>
</tr>
<tr>
<td>Above, plus time shortage for error detection and correction</td>
<td>?? in 1000</td>
</tr>
</tbody>
</table>

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## Human reliability estimate*

<table>
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<tr>
<th>Task</th>
<th>Probability of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task of similar nature to process isolation, with some independent checking of output</td>
<td>3 in 1000</td>
</tr>
<tr>
<td>Above, without independent checking of output</td>
<td>9 in 1000</td>
</tr>
<tr>
<td>Above, plus time shortage for error detection and correction</td>
<td>81 in 1000</td>
</tr>
</tbody>
</table>

Minimum platform error rate = 22 in 1000

*older people are less reliable on perceptual tasks (e.g. reading P&ID diagrams or small print on labels).
Recommendations

- Reducing isolation error rate
- Early detection of isolation errors
- Educate personnel on human error, and performance-shaping factors
- Share learning with other platforms, and other organizations using same control of work software
- Reducing isolation violations

- Result: 66% reduction in errors, and remaining errors are of lower potential consequence
Safety culture and human factors

Key points

- Many process industries need more management focus, tools & techniques for identifying and reducing error, and performance-shaping factors

- Human error includes management error

- More traditional behavioural safety won’t help

- Strong Link to Just & Fair Culture

Strong safety culture: Cannot eliminate error; ATC = 98% error; 2% intentional

Maturing safety culture

Decreasing number of unsafe acts

Intentional (Violation) Unintentional (Error)

Weak safety culture: Error obscured by focus on more obvious violations, and blame

A developing safety culture: 55% violations; 45% error

Capability improvement needed here?
Top-ten tips

• Choose a well-researched human factors analysis tool
• Carefully select those who you train to use this tool
• Include interviewing skills in the training
• Brief senior managers and workforce on potential benefits
• Define type(s) of incidents where human factors analysis is mandatory, and where it is optional
• Include a human factors skillset in the investigation team
• Ensure a clear distinction is made between intentional and unintentional behaviours
• Ensure the investigation and analysis uncovers what influenced unsafe behaviour, or made error more likely
• Give your analysts coaching and feedback to keep skills fresh
• Publicise success
Further reading 1

• General reading about human performance and failure
  o Error and performance-shaping factors
    – Safety at the Sharp End: A guide to non-technical skills, by Rhona Flin and colleagues. Published by Ashgate (2008). $29.00 on Amazon
  
  o Intentional behaviour / violations
    – Bringing out the Best in People, by Aubrey Daniels. Published by McGraw-Hill (2000). $17.00 on Amazon. Short book on ABC analysis, not specifically about safety.

• Energy Institute guidance on investigating and analysing human and organisational factors aspects of incidents and accidents
  o http://tinyurl.com/brswynv
Further reading 2

• Human Failure Types
  o http://tinyurl.com/d5ou9y7

• Interviewing
  o Investigative Interviewing: Psychology and Practice, by Rebecca Milne and Ray Bull. Published by Wiley (1999). $56.00 on Amazon. This is an interesting read for those who want to know some theory and practice on this subject.
  o Investigative Interviewing Explained, by Brian Ord and colleagues. Published by LexisNexis/Butterworths (2008). $86.00 on Amazon.

• Human Factors Analysis Tools
  o A paper published in Process Safety and Environmental Protection - the official journal of the European Federation of Chemical Engineering - which describes methods which have been successfully used to enhance incident investigations, and develop better recommendations to address violations, errors. http://tinyurl.com/cy4cavj

• Human Factors Analysis Tools case study – reducing isolation errors
  o http://tinyurl.com/c2aadaw

• Just and Fair Culture Model
  o http://tinyurl.com/c65nuol