Human factors in incident investigation

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About your speaker

- 14 years experience as a human factors specialist
- Principal Human Factors Advisor for the Keil Centre
- Member of the Human Factors and Ergonomics Society of Australia
Have you ever done the following?

- Knowingly broken the speed limit
- Gone into a room, and forgotten why you went there?
- Stolen something
- Not seen something you want in the supermarket, even though it’s right in front of you
- Done home improvement work, without full PPE
- Daydreamed when you should be paying attention
- Failed to pay your train fare
- Bumped into things or people?
- Told a “white lie”
- Put the right thing in the wrong place (e.g. milk into oven)
Which work behaviours are a problem....?

- Driving over speed limit on company business
- Forgetting an important step in a procedure
- Deliberately taking banned items onto site
- Mis-reading a manual or drawing
- Not using the PPE provided

- Confusing two similar pieces of equipment, or products
- Not wearing seatbelts on fork-lift truck
- Misunderstanding a work instruction
- Using a mobile phone whilst driving
- Pressing the wrong button or lever by mistake
Background & Overview

• Top-ten "human and organisational factors" most relevant to high-hazard industries

• Understanding behavioural causes of incidents

• Developing effective actions

• Further reading & resources

• Questions / comments
GOAL: Managing human reliability & failure

<table>
<thead>
<tr>
<th>Influences on human reliability &amp; performance</th>
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<tbody>
<tr>
<td>Organisational (safety) culture</td>
</tr>
<tr>
<td>Usable procedures</td>
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<tr>
<td>Safety-critical communication</td>
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<tr>
<td>Training and competence</td>
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<tr>
<td>Human factors in design</td>
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<tr>
<td>Staffing levels, including supervision</td>
</tr>
<tr>
<td>Fatigue &amp; shiftwork</td>
</tr>
<tr>
<td>Organisational change</td>
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<tr>
<td>Maintenance, inspection and testing</td>
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</table>
Human Factors Incident Analysis

Traditional Analysis

Gather Evidence → Assemble Timeline → Identify critical factors & causes; write recommendations

CF1  CF2  CF3

Human Factors Analysis

Specify behaviour(s) to be understood

Behaviour Intentional or Unintentional?

ABC Analysis

Human Error Analysis
What is a behaviour?

What a person did, or did not do

- Action
- Observable

Which of these are behaviours?

- Not clipping on when working at height
- Feeling stressed
- Conducting safety observations
- Being prejudiced against women
- Driving up a one-way street
Specifying behaviours to be understood

• Start with critical factor(s)
• What behaviour(s) were associated with the critical factor you wish to understand?
• Specify the behaviour(s) to include:
  – Which person performed the behaviour
  – The task they were engaged on at the time
  – What they did (or did not) do
  – What the result was
• Be specific about any information relevant to the behaviour (e.g. valve line ups, display readings, road signs, diagrams, contracts)
Examples of poor behaviour definition

• “Drove through a gas cloud”
• “Failed to place a tag”
• “Didn’t follow procedure”
• “Was stressed”
• “Tripped over because he was tired”
• “Forgot a step because she was rushing”
Activity: Driving a Hire Car

Activated incorrect lever

Who: Kirsty
Task: Whilst exiting the airport
Action: Activated the windscreen wiper lever, instead of the indicator when changing lanes
Result: Resulting in confusion of other drivers and near collision

Drove over the speed limit

Who: Kirsty
Task: Whilst driving to her meeting
Action: Drove over the signed speed limit
Result: To arrive at her meeting on time
Intentional or unintentional behaviour

Intentional (violation)

- Person announced their intention to behave in that way, prior to the behaviour
- It can be demonstrated that the person knew what should be done
- Their behaviour led to some positive consequences for them

Unintentional (error)

- The person can explain how the error occurred, but not why – they are puzzled by their own actions
- Colleagues have done similar things unintentionally
Understanding intentional violations

- First step in changing behaviour is to understand why people are currently behaving as they are

- ABC analysis helps you to understand behaviour from the other person’s perspective

- Antecedents get us going, consequences keep us going
ABC analysis

- First step in changing behaviour is to understand why people are currently behaving as they are
- ABC analysis helps you to understand behaviour from the other person’s perspective
- Antecedents get us going, consequences keep us going
Example – Answer Telephone

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behaviour</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hear telephone ring</td>
<td>Lift telephone receiver</td>
<td>Have a frustrating conversation with a telemarketer</td>
</tr>
<tr>
<td>Hear telephone ring</td>
<td>Do not lift receiver, let the</td>
<td>Continue working uninterrupted</td>
</tr>
<tr>
<td></td>
<td>answering machine pick up</td>
<td></td>
</tr>
</tbody>
</table>
## Example – Wear Hearing Protection

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behaviour</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearing protection supplied by company</td>
<td>Wearing hearing protection in noisy environments</td>
<td>Reduces the likelihood of hearing loss in the future</td>
</tr>
<tr>
<td>Company requirement to wear hearing protection in specific areas</td>
<td></td>
<td>Less likely to get into trouble with management for not wearing hearing protection</td>
</tr>
<tr>
<td>Signs highlight areas where hearing protection is required</td>
<td></td>
<td>Difficulty hearing their radio / communications</td>
</tr>
<tr>
<td>Knowledge of potential damage to hearing if protection is not worn</td>
<td></td>
<td>Discomfort of wearing hearing protection</td>
</tr>
<tr>
<td>Noisy environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peers do not wear hearing protection</td>
<td>Not wearing hearing protection in noisy environments</td>
<td>Impaired hearing in the future</td>
</tr>
<tr>
<td>Knowledge that rules of wearing hearing protection are not enforced</td>
<td></td>
<td>Avoid discomfort of wearing hearing protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Able to hear radio better in the noisy environment</td>
</tr>
</tbody>
</table>
Different Types of Consequences

• **Positive (P) or Negative (N)**, from perspective of the other person
• **Immediate (I) or Future (F)**
• **Certain (C) or Uncertain (U)**, that consequence will occur

- PICs most strongly influence behaviour
- Ns also influence behaviour, but tend to get the minimum effort
- ABC analysis helps to understand and influence Antecedents and Consequences

- Useful technique to understand and influence unsafe behaviour by managers, colleagues, contractors, visitors....
## Reinforcing Consequences

<table>
<thead>
<tr>
<th>Consequence</th>
<th>Positive / Negative</th>
<th>Immediate / Future</th>
<th>Certain / Uncertain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid hearing loss</td>
<td>Positive</td>
<td>Future</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Avoid conflict with peers</td>
<td>Positive</td>
<td>Immediate</td>
<td>Certain</td>
</tr>
<tr>
<td>Discomfort</td>
<td>Negative</td>
<td>Immediate</td>
<td>Certain</td>
</tr>
<tr>
<td>Difficult to hear radio</td>
<td>Negative</td>
<td>Immediate</td>
<td>Certain</td>
</tr>
</tbody>
</table>
ABC analysis

• Applied behaviour analysis
• Strong research background
• Systematic method to analyse intentional behaviour
• Consequences (largely) drive behaviour
• Underpins behavioural safety
• Much of traditional health and safety effort involves providing antecedents
Human Error Analysis

• Understand why unintentional behaviours occur
• To understand why is to be able to fix it
• Systematic method to ensure thorough analysis
  – Developed for Air Traffic Control
• Internal and external “performance shaping factors”
• Based on information processing model
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
Error Types

Unintentional error = dialling the wrong phone number from your mobile

• Perception error
  – Mistaking a 3 for an 8 on the display screen

• Memory error
  – Recalling 0408 055 059 as 0408 005 059

• Decision error
  – Dialling home from abroad, and getting connected to a local number

• Action error
  – Mis-keying two adjacent numbers
# 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>
Step Change case study: drilling incident

• Driller operating top drive drilling unit
• Stand of drill pipe clamped in the slips; top drive was raised; held on the brake
• Driller used microphone to intervene with a worker on the rig floor
• Slightly released pressure on the brake
• 27kg pipe guide fell 90 feet to the floor, narrowly missing the worker on the rig floor
What human factors were involved?

<table>
<thead>
<tr>
<th>What human factors were involved?</th>
<th>Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What did people do intentionally?</strong></td>
<td>• Human Factors in Design</td>
</tr>
<tr>
<td>People accepted the poor layout and controls, and got on with the job</td>
<td></td>
</tr>
<tr>
<td>As different items of equipment were added, controls were placed</td>
<td></td>
</tr>
<tr>
<td>wherever they could be, without considering how they would have to be</td>
<td></td>
</tr>
<tr>
<td>used together. Many different people knew about the problems in the</td>
<td></td>
</tr>
<tr>
<td>dog-house, but a “can do” attitude meant that people just put up with</td>
<td></td>
</tr>
<tr>
<td>poorly designed equipment and controls.</td>
<td></td>
</tr>
<tr>
<td><strong>What did people do without meaning to?</strong></td>
<td>• Risk Assessment</td>
</tr>
<tr>
<td>The driller released hand-pressure on the brake control</td>
<td></td>
</tr>
<tr>
<td>If the brake-control had been entirely released the brake would have</td>
<td></td>
</tr>
<tr>
<td>applied automatically. Unfortunately, a small release in hand-pressure</td>
<td></td>
</tr>
<tr>
<td>was enough to remove the brake. Keeping your arm steady during a task</td>
<td></td>
</tr>
<tr>
<td>requires concentration and balance. Changing your position affects</td>
<td></td>
</tr>
<tr>
<td>this fine-control. The movement towards the microphone reduced</td>
<td></td>
</tr>
<tr>
<td>pressure on the brake and the top drive descended.</td>
<td>• Managing Human Failures</td>
</tr>
</tbody>
</table>
What can we learn from this incident?

- Older equipment has sometimes been subject to incremental change, without any thought to how changes will interact. Apply a good quality management of change process to each change, to identify these interactions before they become a problem.

- Our ability to carry out physical fine-control tasks is influenced by our body position and balance, and requires concentration. An ergonomist can advise on what people will be physically capable of in different situations.

- People will put up with poorly designed equipment and make the best of it. Designers can’t foresee all situations. Speak up if there is equipment which is difficult to operate.

- Get experienced end-users involved in the design and commissioning of equipment.
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
In conclusion

• Do your investigators have the skills and qualities to effectively analyse the human factors in investigations?

• Do your incident investigations get to underlying “human factors”?

• Is error sufficiently well-recognised and managed in your organisation?
  – Design, Operations, Maintenance

• Is the workforce willing and able to report “performance-shaping factors”, and is management ready for this?
Further information & resources

• “Reducing Error and Influencing Behaviour”
  – Download free at www.hsebooks.co.uk - search for HSG48

• The Keil Centre Ltd publications

• UK Health and Safety Executive HOF web-site

• US Chemical Safety Board Safety Videos

• Energy Institute HOF briefing notes

• Step-Change in Safety
  – “Human Factors – how to take the first steps” – search in Google
Questions?

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