Why organisations should employ HF experts in accident investigations

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1

What Makes Behaviour 'Accidental'?

2

- Accidents may be rare but the behaviour of those involved at the time is often perfectly normal
- But things just went wrong anyway (for some reason!)
- Why?

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The Growth of Human Factors

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- Many organisations now employ Human Factors (HF) specialists in a variety of roles
- Safety is a growth area for the employment of HF specialists, including accident investigation. Typically, HF experts either support investigation teams or act as investigators after additional training.
- How does HF add value to investigations?
  - By analysing how the working conditions at the time influenced the behaviour of those involved
  - By analysing how those working conditions came about in the first place.

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The Scissors Analogy: Human Factors is NOT about People

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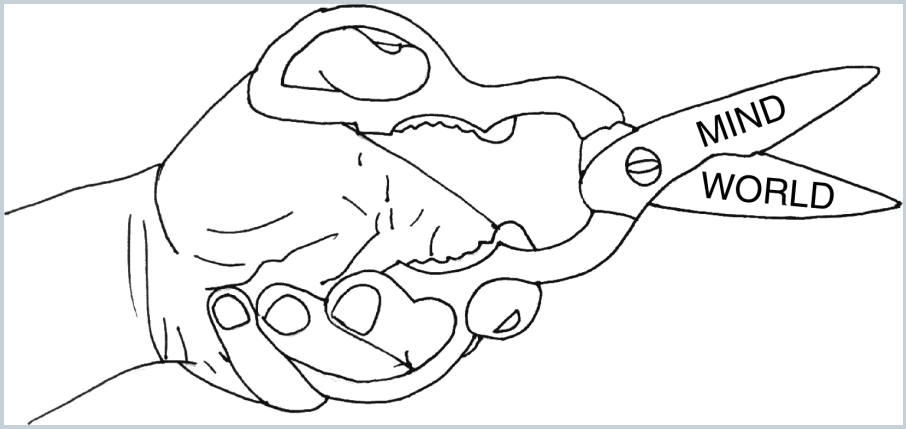

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Human Factors Helps Us to Understand the Behaviour of People in Systems by understanding the System they are Part of

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- Most of the national and international human factors and ergonomics societies have professional competency frameworks
- These competencies support investigations by prompting the investigators to ask good questions and analyse the answers
- The competencies themselves are based on over 70 years of peer-reviewed research
- These competencies enable subject matter experts in HF to take a *systems approach*

5

Competencies: What are they?

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Competence = Knowledge + Experience

- Foundation
- Beginner
- Practitioner
- Expert

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Competencies: Training

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Competence = Knowledge + Experience

- Foundation and beginner level training
- 1,3 or 5-day courses
- Face to face or online for 1 and 3 days

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Stepwise Application of Human Factors in Investigations

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- Step 1: Gather information. Human factors has a large knowledge base that can be used to inform the search for information (and easy to use checklists)
- Step 2: Search for and establish facts. Once the information has been gathered, it can be interpreted to establish the key facts. A human factors advisor will be able to assist in the interpretation of the key facts and explain *why* they were relevant. There is an extensive body of scientific literature in human factors that can be used to support the interpretation of the findings. In other words, the key facts are established on the basis of scientific knowledge backed-up by scientific literature and not on the 'hunches' of the investigators.
- Step 3: Establish essential contributing factors. By taking a systems approach contributing factors (known as '*performance shaping factors*' in human factors) can be identified
- Step 4: Find root causes. Not all accidents have root causes, but human factors does assist in establishing the causal contributions of different contributing factors
- Step: 5 Determine corrective actions. The literature on human factors contains a wealth of guidance for improving the reliability and resilience of systems
- Step 6: Implement corrective actions. Human factors professionals can advise on the design and implantation of corrective actions and assist with their subsequent assessment/audit once implanted (NB. Human Factors Integration is a separate topic)

8

What do PSFs Look Like?

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- The speaker once purchased a 3.15kg tin of green olives from a supermarket, by mistake, while out shopping early one Saturday morning
- He prefers black olives
- Can you find *at least* 3 PSFs?
- Is there a root cause?

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Two faces of System Safety

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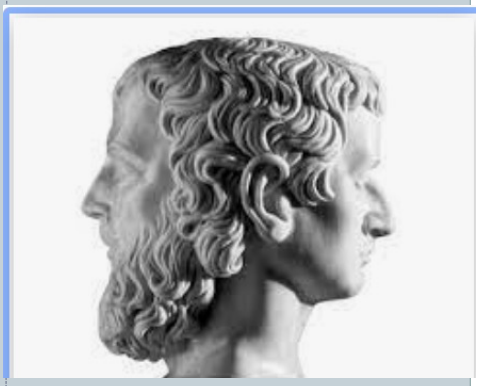
- Was it operated safely?
- Was it safe to operate?
- There is often a tendency in investigations to focus on 'human error'
- On those involved at the accident site at the time
- Distracting attention from wider issues
- People make mistakes all the time. Normally, nothing happens



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Human Error and Sampling Bias

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	Safety Occurrence?	
Human Error? Violations?	Yes	No
Yes	Blame the worker	'Unknown unknown'
No	Blame something else	Taken for granted

11

Operational Safety vs System Safety

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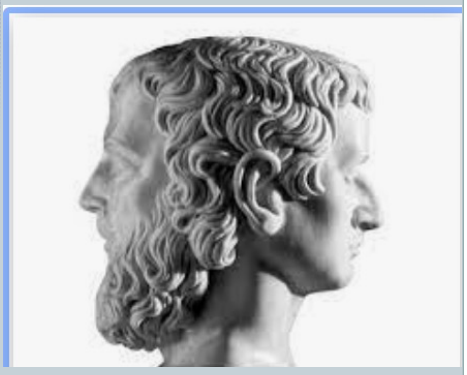
		Was it Safe to Operate?	
		Yes	**No**
Was it Operated Safely?	**Yes**	**True accident**: a ship is hit by a freak wave that could not have been predicted. The event was not foreseeable. No mitigation was possible	**Technical failure**: Personnel were operating the system correctly. Design faults led to component failure (e.g. a pressure relief valve malfunctioned) or unpredictable behaviour of an automated subsystem lead to the event.
	No	**Violations or errors**: The ship ran aground because of poor communication between an understaffed and poorly trained group of officers on the bridge. Departures from standard operating procedures and danger signs were communicated but ignored or misunderstood	**System-induced error**: The automatic system defaulted to a rarely-used operating mode that was not displayed. The operators misinterpreted the behaviour of the system and failed to recognise the warning signs due to poor training and supervision.

12

Looking Backwards and Outwards

13

- A task analysis is a good place to start in an investigation
- To answer two questions:
  - What happened?
  - What's supposed to happen?
  - How is it supposed to happen?
- Leading to further questions about the equipment, maintenance, training and the environmental conditions
- And the safety management system itself



13

Analyse the Task and the Tech

14

- Human Factors Specialists are trained to conduct task analyses
- Starting at the Human-Machine Interface, we can reconstruct what happened during a thin slice of time in the immediate vicinity
- We can identify PSFs that make tasks unsafe
- This can lead to deeper questions about how the organisation designs its systems and how safety is managed

14

Proximal Errors and Distal Errors: Questions worth asking

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- What happened?
- What's supposed to happen?
- How is it supposed to happen
- Has it happened before (the safety occurence)?
- How did the organisation respond when it happened before?
- Where there hazards/PSFs in the work environment when the accident happened?
- Did anyone know about them?
  - Were they recorded in the hazard log?
  - Were they noted in the minutes of the safety committee meetings?
- How did the hazards get there?
  - By chance?
  - Through weaknesses in the safety management system?
- The proximal error is often the last of many previous errors!

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Recap

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- Human Factors is not about people, its about systems
- The focus is on the interaction between people and technology and the factors affecting the interaction
- The scissors analogy – the focus is not just on what people did wrong, but why and why the behaviour resulted in an accident
- The systems approach is fundamental:
  - Focus on the system components and how they fit together
  - The interdependence between the components
  - How the components were integrated and the work organised

16

Case Study: An incident with a root cause

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- Management of venous-thromboembolism risk in patients
- 78-year old woman admitted to hospital after suffering a stroke
- A doctor conducted a risk assessment
- IPC device prescribed but NOT written to the chart

17

Case Study: An incident with a root cause

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- A second assessment – due to be carried out 12-hours after the first - was omitted
- A few weeks later the patient started having trouble breathing after blood clot appeared in her lungs
- A clinical trial of IPC devices gives us some interesting insights
- The *absolute risk* of suffering an adverse outcome when an IPC is fitted is reduced by 6%
- However, the *relative risk reduction* (in those susceptible) is 25-46%

18

Human Factors Analysis

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- The policy distributes responsibility for the process to different team members
- If key steps are omitted, the process defaults to *no treatment*
- When multiple goals are combined in the same process *goal substitution* may occur (completing the assessment rather than writing to the chart)
- If the IPC is not written to the prescription chart, nurses will assume that it is not needed (an error of omission is *assumed to be a positive indication of safety*)

19

Errors of Omission and Commission

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- Omission-device not fitted: consequences potentially very serious
  - Outcome-based detection (patient gets very ill or dies) too late
- Commission: Only 5% of patients contra-indicated
  - Process-based detection is possible (nurse sees the contraindications such as leg sores when she tries to detect the device)

20

Who's to Blame?

21

- Doesn't matter. The purpose of a safety investigation is to make safety recommendations, not to find someone to blame
- Somebody might be to blame but this is best done in a separate and independent investigation by a different team of suitably qualified personnel

21

Sensemaking: How Human Factors Adds Value

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- Sensemaking: *"The ongoing retrospective development of plausible images that rationalize what people are doing" (understanding operator actions in relation to intentions and goals)**
- *"Sensemaking has often been limited to an organizational context, seldom discussing issues such as system design…….. it is pointed out that safety science seems to have drifted from the engineering and design side of system safety toward organizational and social sciences or refinement of probabilistic models; thus, there is a need to focus more on design and design principles to be able to diagnose hazardous states in operations"**
- ……..And that's why organisations employ human factors professionals

* Kilskar, S.S., Danielsen, B.E., Johnsen, S.O.: "Sensemaking in Critical Situations and in Relation to Resilience—A Review" - ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part B: Mechanical Engineering; September 2019, DOI:

22

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23

INTRODUCTION TO HUMAN FACTORS IN ACCIDENT INVESTIGATION

23