PROTECTING PEOPLE
AND PLACES FOR 50 YEARS HSE

HF in the Health and Safety Executive

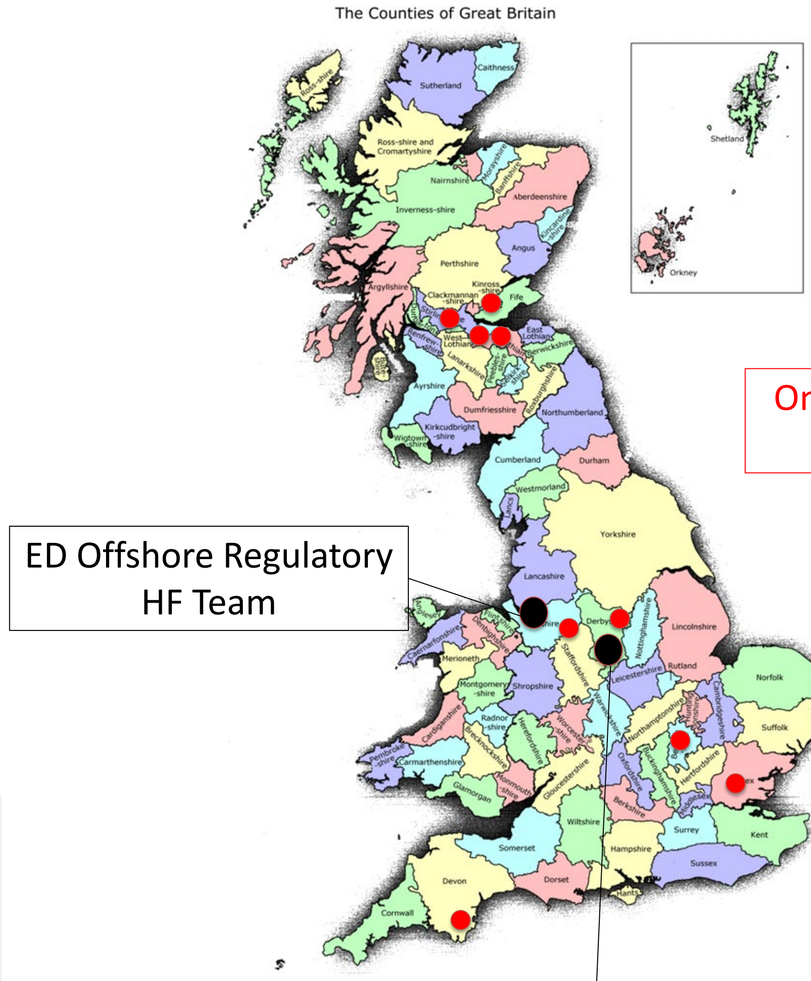
Garry Moon, Principal Specialist Inspector –
Human Factors

Aims are to outline:

- How Human Factors is structured in HSE
- How we regulate Human Factors management in Britain
- What happens when Human Factors is not considered

PROTECTING PEOPLE AND PLACES FOR 50 YEARS HSE

Human Factors Teams in the HSE



Onshore Regulatory HF Team

ED Offshore Regulatory HF Team

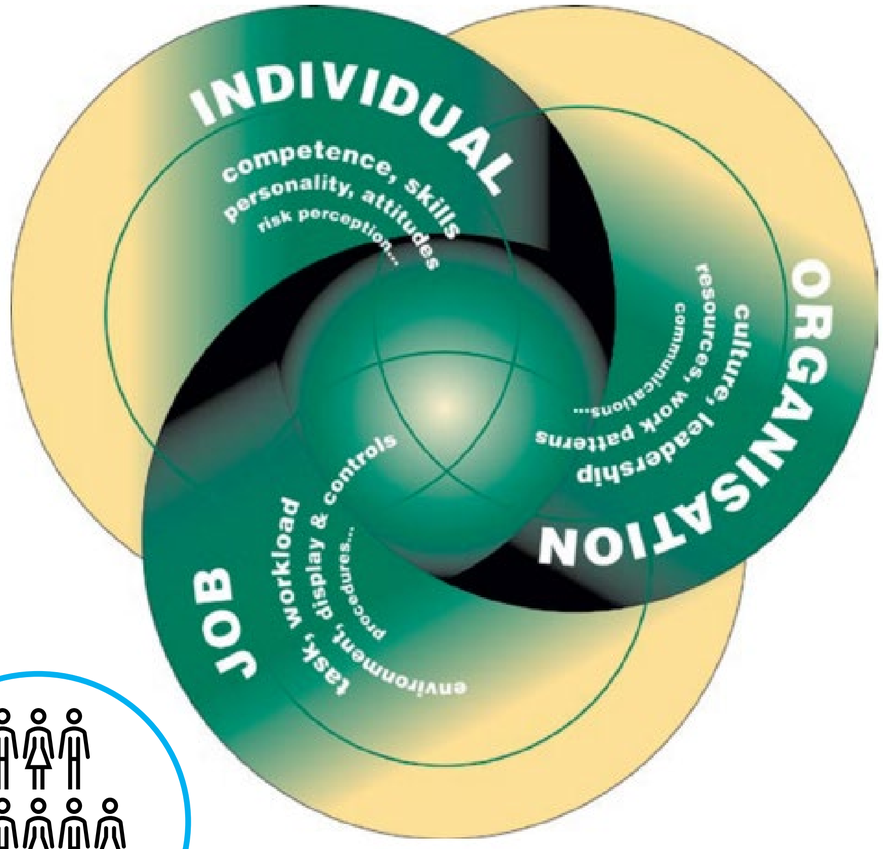
Science Division

Onshore Regulatory HF Team:

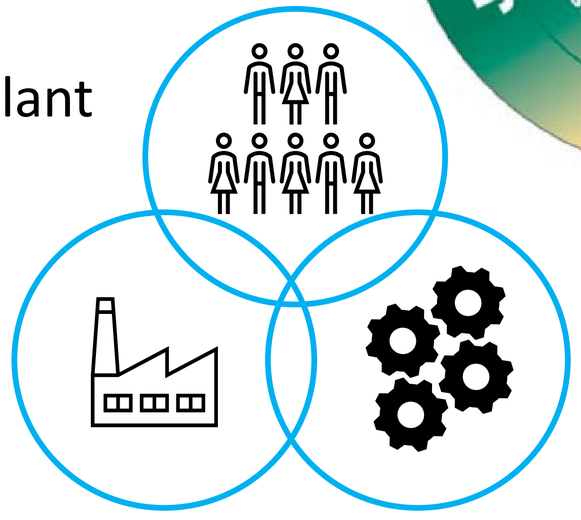
- ~90% of our work is proactive Inspection
- ~10% is reactive incident investigation

Human Factors

‘Human factors refer to environmental, organisational and job factors, and human and individual characteristics which influence behaviour at work in a way which can affect health and safety’ (HSG 48)



Or interface between people, processes and plant



Human Factors Team

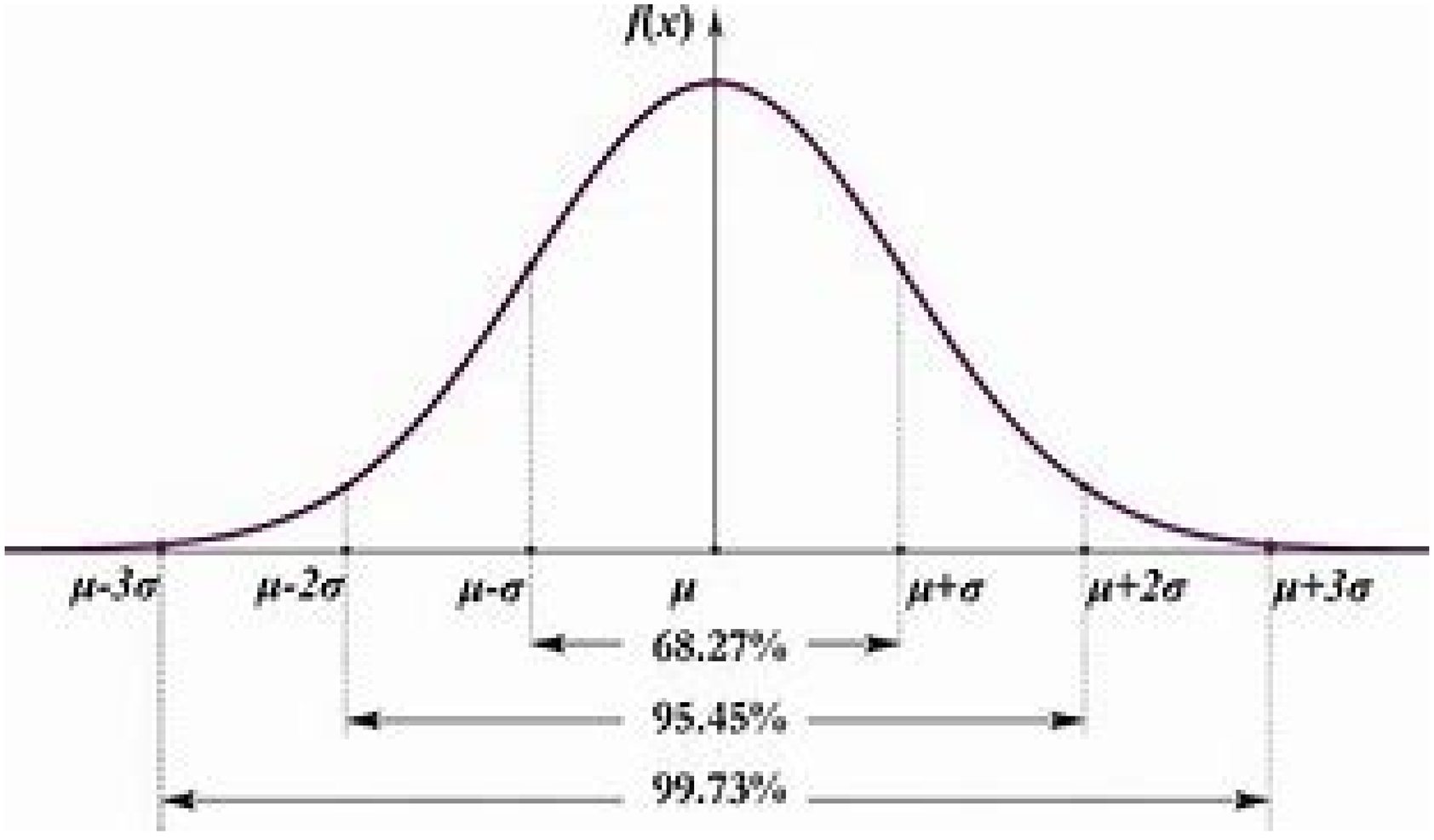
Multidisciplinary:

- Ergonomics – The scientific study of work
  Chartered Institute of Ergonomics and Human Factors, established 1949, Royal Charter 2014

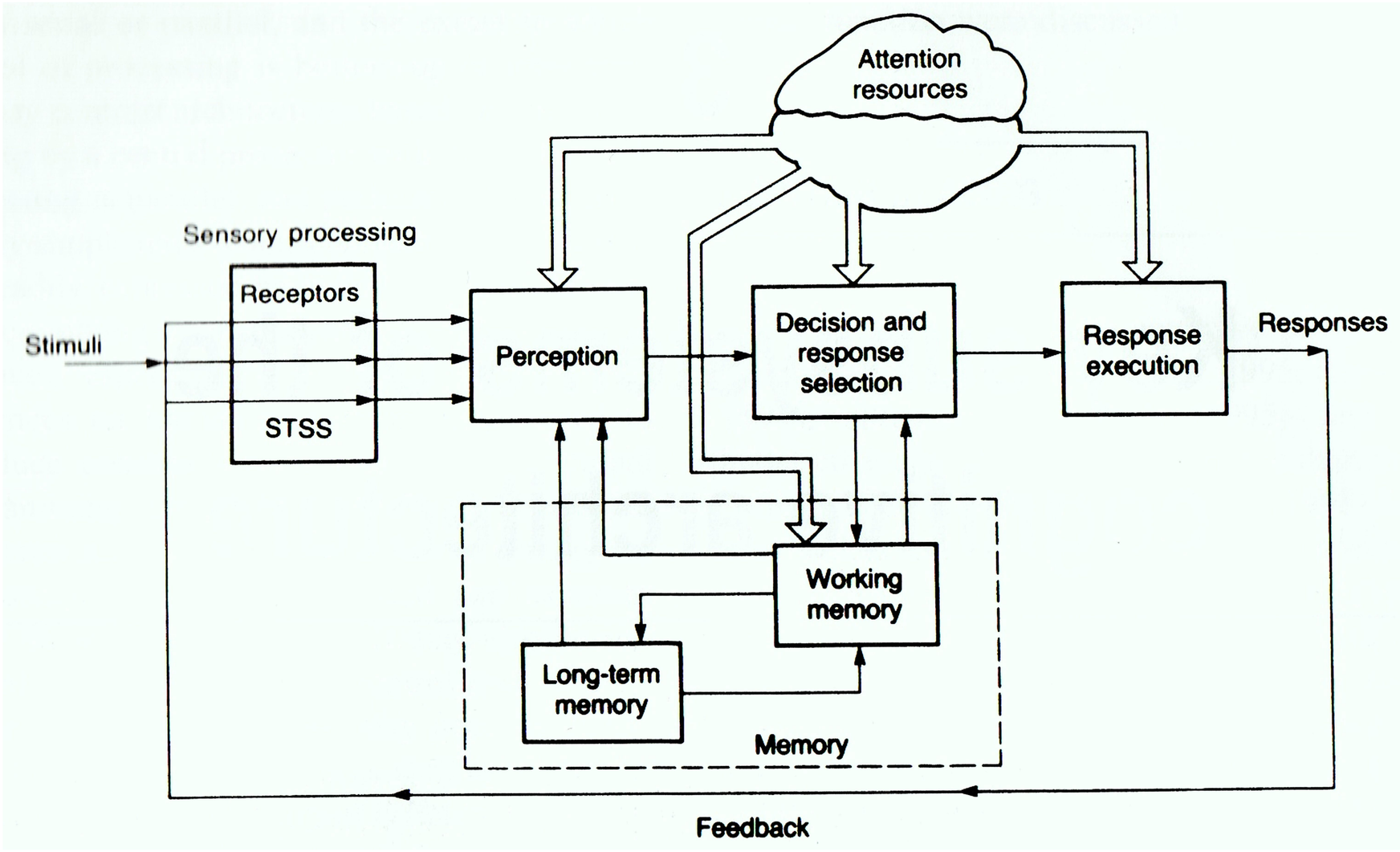
- Psychology (Occupational and Organisational) – The study of behaviour and performance at work
  British Psychological Society, established 1901, Royal Charter 1965

Both concerned with optimising human performance and reducing error potential

Variation



Cognitive Processing issues:



Memory

- Donald, 49yr old American
- First operation in May 2000 to remove abdominal tumour
- Complained of increasing pain post operation
- Set off metal detectors at airports

Gossypiboma

Example HF relevant British Regulations

- Control of Major Accident Hazards Regulations 2015 – L111 states:

  'Where reliance is placed on people as part of the necessary measures, human factor issues should be addressed with the same rigour as technical and engineering measures'

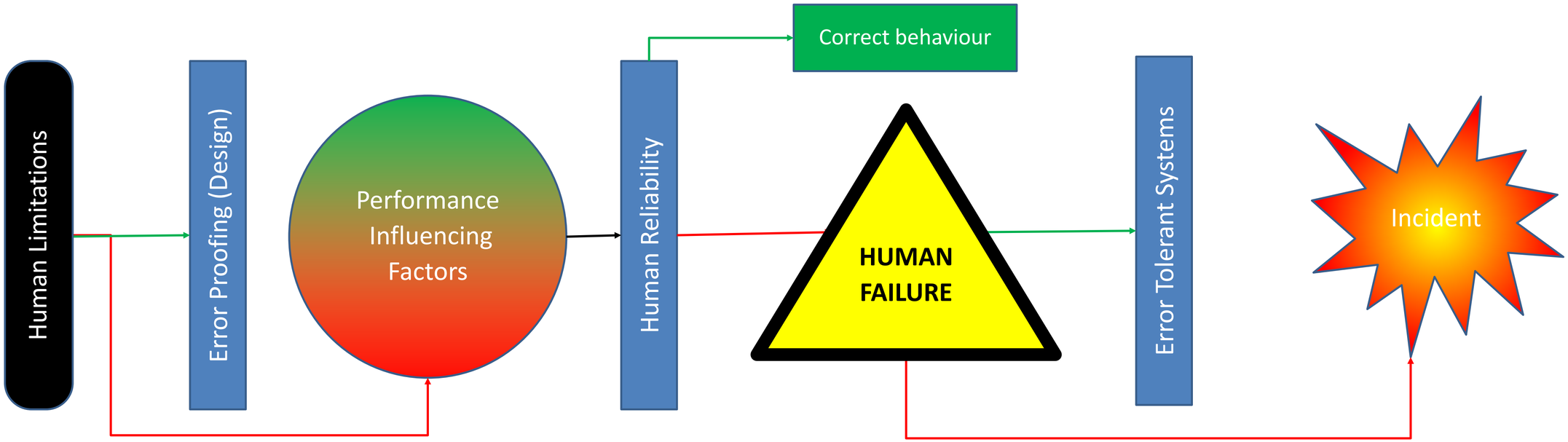
- Provision and use of work Equipment 1999 – e.g. Suitable and sufficient Work Equipment, Information and instructions; training . . .

- Management of Health and Safety at Work Regulations 1999 – e.g. Risk Assessment , H&S Arrangements (*effective planning, organisation, control, monitoring and review of the preventive and protective measures*)

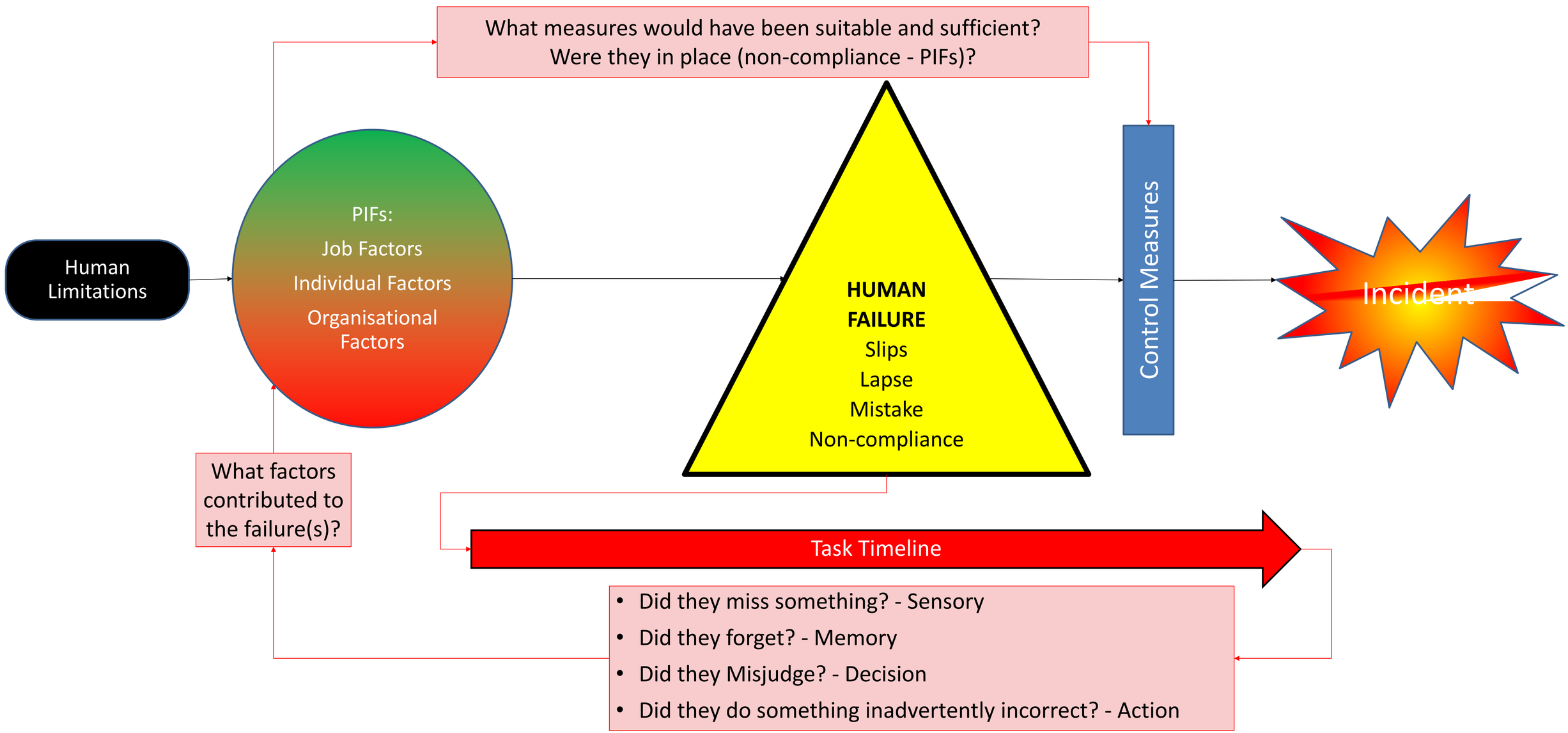
Topics for inspections:

- Topic 1 Managing Human Performance - HF Risk Assessment and Investigations
- Topic 2 HF in Process Design - Human Machine Interaction, Control rooms, Alarm management; Lighting, thermal comfort, noise and vibration; MoC
- Topic 3 Critical Communications - Shift handover, Permit-to-Work)
- Topic 4 Design and Management of Procedures
- Topic 5 Competence Management Systems
- Topic 6 MoOC, Fatigue, Shiftwork, Workload, Staffing Levels

Human Failure Management Simplified



Human Factors Investigation Simplified



Incident = Person's fault?

Task	'Typical' Failure Probabilities
Human Performance: trained with no stress (simple tasks)	1 in 1,000 to 1 in 10,000
Routine task needing concentration	1 in 50 to 1 in 100
Human Performance under stress	1 in 2
In practice:	
Select wrong switch among similar looking items	1 in 200
Read an analogue indicator wrongly	1 in 200
Put 10 digits into a calculator	1 in 20
Fail to act correctly after 1 minute in an emergency	9 in 10

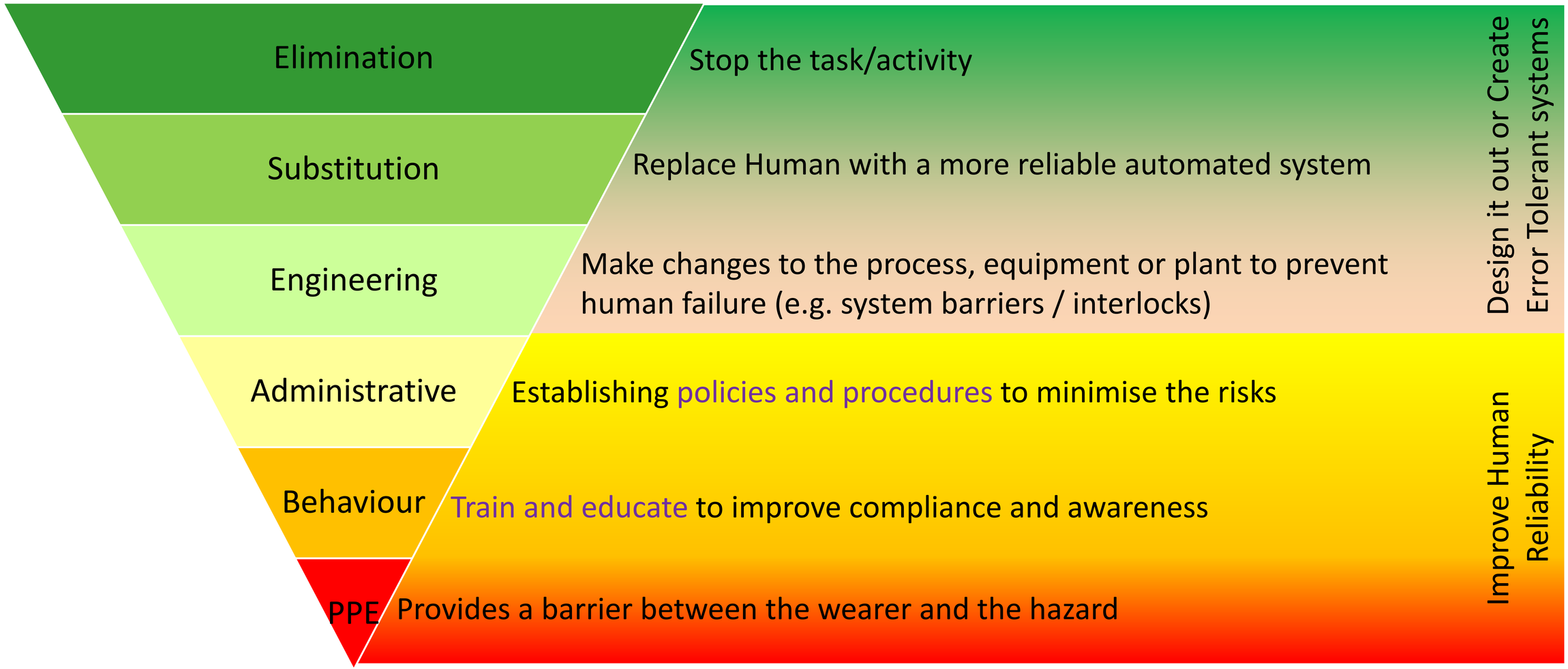
To err is human …

That doesn't mean organisations can't do something about it!

Human Factors is about:

- Predicting where people can get it wrong
- Working out what makes that more or less likely AND
- Doing something about it.

Control of variability



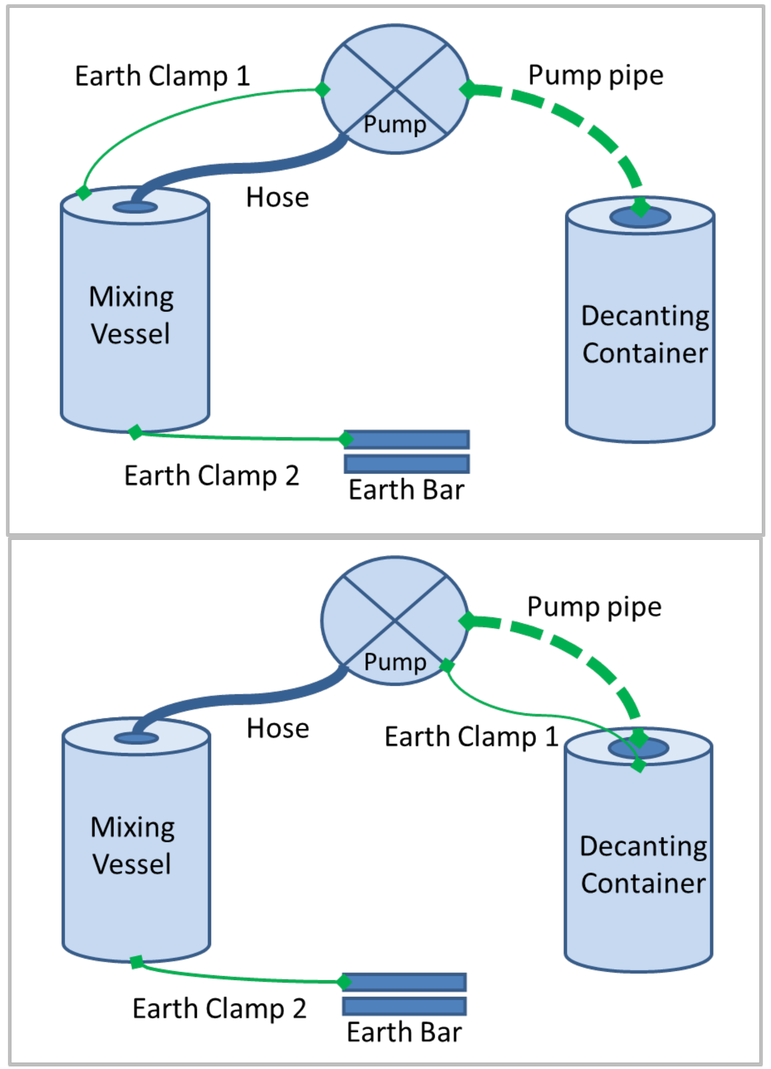
PROTECTING PEOPLE
AND PLACES FOR 50 YEARS HSE

Examples

Fire at industrial site – Earthing connection Error

PIFs:

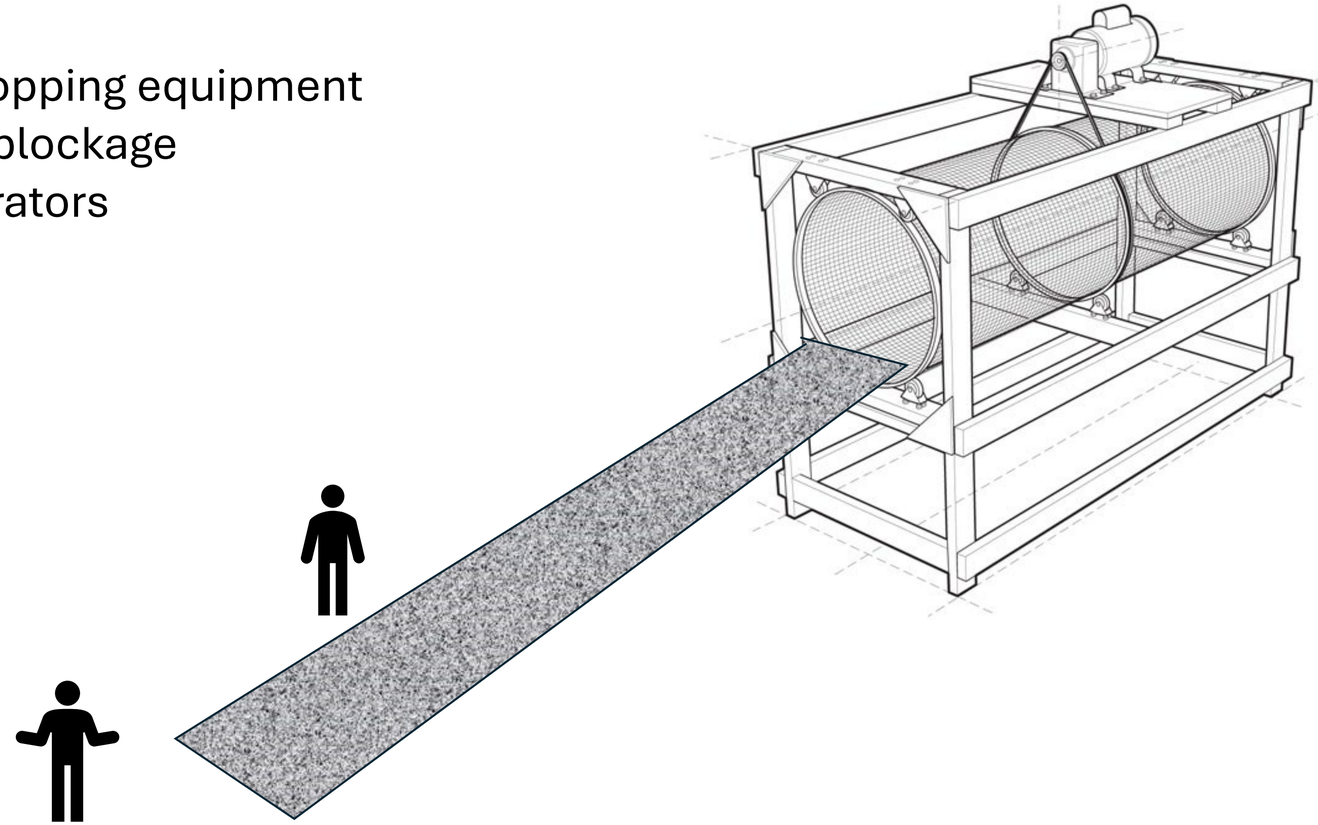
1. Experienced Operators
2. Task done many times a day
3. No written procedure as simple task
4. Two-person operation (including moving drums)



PROTECTING PEOPLE AND PLACES FOR 50 YEARS HSE

Waste Recycling Incident

1. Blockage of trommel led to stopping equipment
2. 2 people attempt to clear the blockage
3. Trommel started by other operators



Locomotive Explosion

Background: A locomotive was used to support construction activities on an underground railway. A driver and attendant would operate the locomotive. The journey included an unpedestrianised tunnel section with a steep downhill slope, followed by steep uphill slope.

The locomotive should not have exceeded 30 kmph for safety reasons.

Incident: While travelling in the tunnel section of the track the locomotive exploded, killing the two operators on board. It was hypothesised that they might have been travelling faster than 30kmph.

Expert Witness Questions:

1. How and why do people violate procedures?
2. What could explain a drivers' decision to break the 30km/h speed limit for the locomotives?

Behaviour: Speeding over 30kmph in tunnel

PROTECTING PEOPLE AND PLACES FOR 50 YEARS HSE

Antecedent	Consequence	R/P	N/L	S/U
Exp: High loading of Locos led to jumping out of gear – Weight + gradient = HL – drivers not told of load weight	Prevent loud noise, damage to loco, reduction in speed & delays	R	N	U
Exp: Brakes lock when overused, particularly on downhill section	Prevent lengthy freezing process - delays	R	N	U
Belief: Risk of being hit by following train while in tunnels, greater than over speeding	Prevent collision with other train	R	L	U
Exp: Faults reported by drivers not rectified	Reinforces speed is not important	R	N	S
Exp: White working period allowed drivers to go as fast as they could up to 30kmph, downhill sections allowed loco > 30kmph	Reinforces limit for pedestrian & faster progress is management goal	R	N	S
Belief - 30kmph was for pedestrian protection (e.g. speed limit warning plate not fitted on loco)	No pedestrians allowed in tunnel section = Reinforces speeding for to make progress	R	N	S
Belief: Radar speed check (but not used in tunnels)	Disciplinary action for speeding	P	L	U

Example: Swimming Pool Fatality - SEEV model

Investigation

How did a lifeguard miss someone drowning in clear view?

Task PIFs: CCTV

- 9 feeds – 8 used for analysis
- 92mm by 74mm
- Viewed at 750mm (175cm person)
- Lower section obstructed by bar (height dependent)
- Blue hue
- Clarity reduces towards Lane 4 & 5

Measures to support Vigilance

Shift patterns	Resource	Rotations	Rest between following rotations
Consistent start times throughout week Full time 5 shifts in 7 days plus casual cover allowed Shift Length – 8.5 hours 1 abnormality noted (HSG 256)	5 lifeguards on shift at time of incident	Target: RLSS – 60 minutes PSOP - 20 minutes at each of the 3 LP locations 19-21 minutes recorded	Dryside-LP1 had 36 minutes, LP1 has had 37 minutes off poolside, LP2 and 3 were fresh to poolside.

External Factors

1. The IP was regular swimmer
2. He was a lane swimmer (slow lane in shallow pool)
3. He agreed with the other lane swimmer not to swim in circuits
4. He had swum 3 lengths
5. He was swimming breaststroke with good form
6. He was a slow swimmer
7. His submersion was gradual
8. His body position under the water was in a normal position
9. He had epilepsy

External Factors & Selective attention:

Salience ↑	Expectancy ↑	Value ↑	Effort ↓
↓ Slower Swimmer	↓ Lane swimmer – bidirectional constant motion (not in recreational area)	↓ The IP's perceived competence	↑ Head Movement (Pool)
↓ Stroke	↓ In pool not poolside	↓ Frequent swimmer at the pool	↑ Neck Movement (Pool and to display)
↓ Noise	↓ Potential distractions – a couple in the recreation area	↓ Lane swimmer	↑ Eye Movement (Display)
↓ No abrupt change	~ 5:5:20 and 10:20 scanning:	↓ Good stroke	↑ ~ every 20 seconds (Theorectically)
↓ Gradual Submersion	Equal scanning time (theoretically)	↓ Completed 3 lengths	
↓ Stroke continues underwater	Minimum 11 chunks of information	↓ Perceived not to be in a vulnerable group	
↓ Lane 4/5 hardest to see in CCTV		↓ Position, underwater was not abnormal under the water	

Conclusions

Humans are bad at scanning for, and detecting infrequent events which have low signal to noise ratio!

This is why . . .‘Other industries, for example, petrochemicals, would not allow reliance on human vigilance for a safety critical task, instead risks are mitigated via alarm systems to bring abnormal situations to the attention of the operator.’

And The company has now put a drowning detection system in place which uses the CCTV cameras to support lifeguards

Example Support

1. Theme park: Suitability of control measures - task **monitoring and behavioural controls**.
2. Prison transportation: Inadequate **communication** of critical information about a prisoner and risk assessment
3. Police; **why** a death in custody was not noticed for some time despite having continuous monitoring of cell CCTV in place **(monitoring and task design)**
4. Vehicle repair: **Why** a very experienced mechanic decided to change a broken airbags on a trucks suspension system without using a jack, just the other three airbags to support the weight