Human Error Assessment – Minimising Error and Motivating Safe Working

How does safety management motivate people to work safely?

What conflicts does mixed messages generate?

What are the essential elements of motivating people to work safely?

What causes safe or unsafe behaviour to become a safe habit?

What can we learn from the Human Error Assessment & Reduction Technique (HEART)?

UKOPA/07/0067

What is Safety at Work all about?

- Accident Prevention

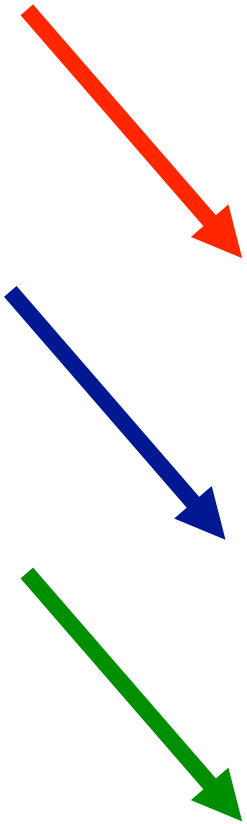
AIM

- to have no accidents at work

BELIEF

- that ALL accidents can be prevented

How do we Manage Safety?



Safety Management Systems

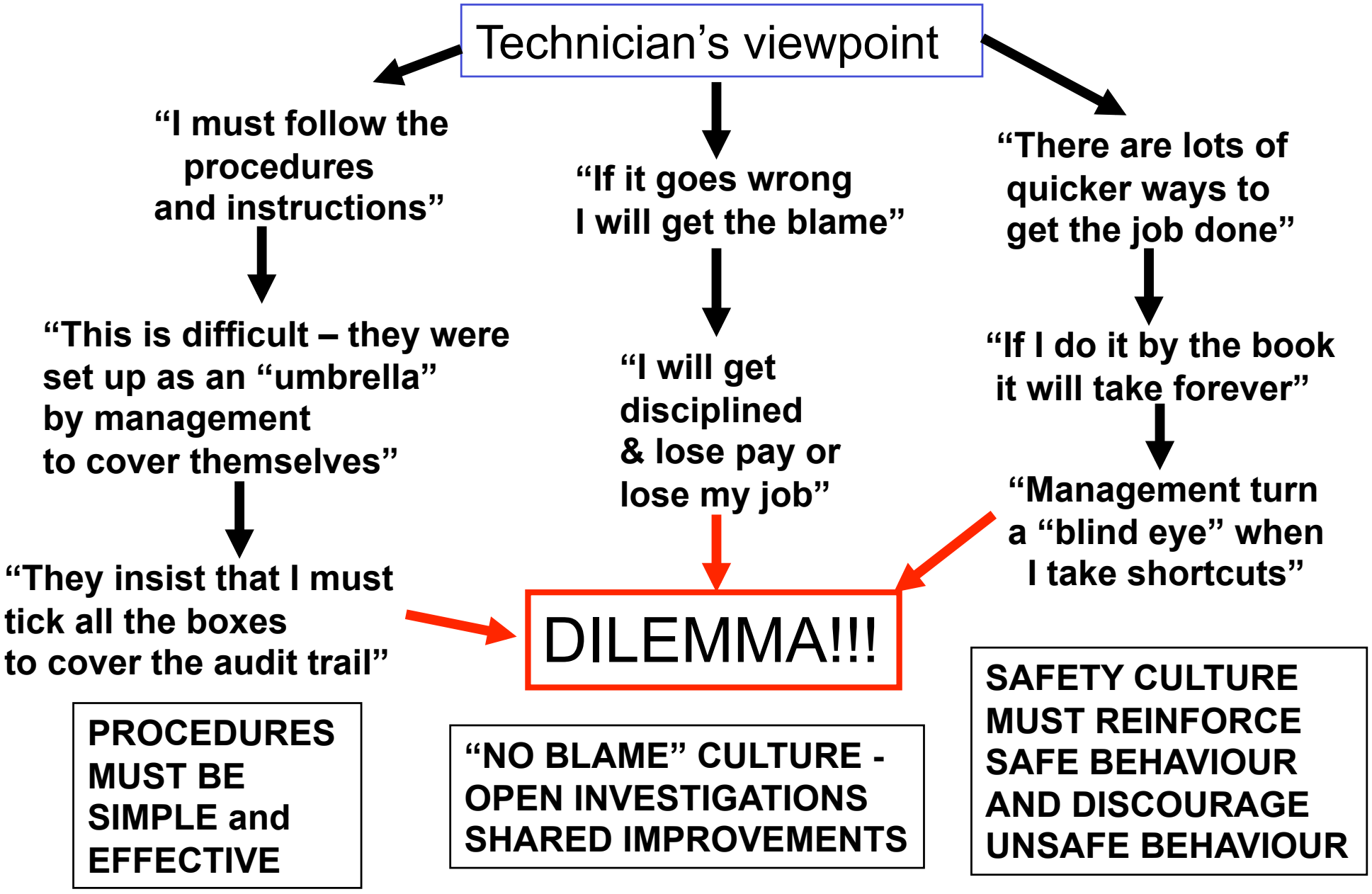
- Setting up how to do it safely

Technical or Process Safety

- Making sure the plant operates safely

Motivational or People Safety

- Getting people to work safely


Technician's viewpoint
"I must follow the procedures and instructions"
"This is difficult – they were set up as an "umbrella" by management to cover themselves"
"They insist that I must tick all the boxes to cover the audit trail"
"If it goes wrong I will get the blame"
"I will get disciplined & lose pay or lose my job"
"There are lots of quicker ways to get the job done"
"If I do it by the book it will take forever"
"Management turn a "blind eye" when I take shortcuts"
DILEMMA!!!
PROCEDURES MUST BE SIMPLE and EFFECTIVE
"NO BLAME" CULTURE - OPEN INVESTIGATIONS SHARED IMPROVEMENTS
SAFETY CULTURE MUST REINFORCE SAFE BEHAVIOUR AND DISCOURAGE UNSAFE BEHAVIOUR

Motivating people to work safely requires

- simple effective procedures, enforced and used
- "no blame" culture for genuine mistakes and errors, open investigations, shared improvements
- changing the culture within the organisation, so changing attitudes to safety, and safety behaviour
- positively reinforcing safe behaviour, and discouraging unsafe behaviour
- "the behaviour you walk past is the behaviour you accept"

Burkhardt 1980

Start with safe behaviour

2 possibilities depending on Safety Culture

It has comfort, safety, there are advantages in doing it this way

We tend to repeat this behaviour because it has advantages and brings success

External reinforcement (by others) of this behaviour makes it desirable for us to continue

It becomes a safe habit

More likely to occur

It requires more time
It has disadvantages
It leads to failure

We tend to change to easier short cuts which are less safe

This has advantages obtains success, so we repeat this behaviour

It becomes an unsafe habit

Burkhardt 1980

Start with unsafe behaviour

2 possibilities depending on Safety Culture

We experiences an accident or near-miss

↓

Causes Pain, punishment, fear, disadvantage, failure, - this tends to change our behaviour

↓

External reinforcement (by others) of change to safe behaviour has advantage, success

↓

Becomes a safe habit

More likely to occur

Saves time, easier, short cut, more convenient

↓

It brings advantage, success, we tend to repeat unsafe behaviour

↓

Prestige among peers - this success strongly reinforces unsafe behaviour

↓

Becomes an unsafe habit

What can we learn from the Human Error Assessment & Reduction Technique (HEART)?

- Task unfamiliarity increases the error rate by up to 17 times
- Shortage of time ……..11 times
- Low “signal to noise” ratio……10 times
- Information over-ride / ignored…….9 times
- Poor information ……8 times
- Design mis-match……8 times
- Mistake correction unforgiving……..8 times

HEART – Human Error Assessment and Reduction Technique

- pragmatic method devised to define how to quantify human error
- developed by Dr J C Williams for the nuclear industry in 1980s
- applied to a task or activity critical to the safety of whole activity
- takes 38 Error Producing Conditions (EPCs) into account based on 100s of human error experiments since the 1920s
- first define failure mode (omission, substitution, repetition, transposition, timing) which causes hazardous situation to occur
- then assign “base-load” failure rate

HEART – Human Error Assessment and Reduction Technique

Generic Task Description	RATE	LIMITS
A. Totally unfamiliar CTS, performed at speed with no real idea of likely consequences.	0.55	0.35 to 0.97
B. Change or restore system to a new or original state on a single attempt without supervision or procedures.	0.26	0.14 to 0.42
C. Complex task requiring high level of comprehension and skill.	0.16	0.12 to 0.28
D. Fairly simple task performed rapidly or given scant attention.	0.09	0.06 to 0.13
E. Routine, highly practiced rapid task involving relatively low level of skill.	0.02	0.007 to 0.045
F. Change or restore a system to original or new state following procedures, with some checking.	0.003	0.0008 to 0.007
G. Completely familiar, well designed, highly practised, routine task occurring several times per hour, performed to highest possible standards by, highly motivated, highly trained and experienced person, totally aware of the implications of failure, with time to correct potential error, but without the benefit of significant job aids.	0.0004	0.00008 to 0.009
H. As for G, but responds incorrectly to system command even when there is an additional or automated supervisory system providing accurate interpretation of system state.	0.0002	0.00006 to 0.0009

HEART – Human Error Assessment and Reduction Technique

- then assess Error Producing Conditions which apply:-

No	Error Producing Condition	Multiplier
1	**Task Unfamiliarity** – based on assessment of how often the task is carried out, familiarity and training for the task, and job aids such as written checklist	Maximum of 17 times
2	**Time Shortage** – assessment of how long the task has to be completed in, taking into account complexity of task, timescale for physical and mental operations concerned	Maximum of 11 times
3	**Low Signal-to-Noise ratio** – assessment of how difficult it is to see or hear what is going on, relative amount of feedback from the task, and clarity of what is required to complete it	Maximum of 10 times
4	**Information Over-ride** – assessment of how easily information can be ignored or not acted on, alarms can be cancelled and ignored, trips left defeated and how easy it is to fail to use safeguards and safety equipment.	Maximum of 9 times
5	**Poor Information** – assessment of spatial and functional information provided, ergonomics of information displays, how well critical information is displayed	Maximum of 8 times

HEART – Human Error Assessment and Reduction Technique

6	**Design Mismatch** – assessment of whether designer's intent is clear to the operator, whether there is confusion in the purpose and operation compared to the design intent	Maximum of 8 times
7	**Mistake Correction** – assessment of whether system is "forgiving" allowing mistakes identified and corrected before proceeding, and checking at each stage before proceeding	Maximum of 8 times
8	**Operator Overload** – assessment of whether operator has too many tasks to deal with during critical operations	Maximum of 6 times
9	**Opposite-to-Normal** – whether operations have to be carried out in an unusual or unexpected way, such that operator has to unlearn a technique and apply opposite philosophy	Maximum of 6 times
10	**Knowledge Transfer** – assessment of whether operator has to carry critical knowledge (settings, calculations) from one task to the next which he has to remember to carry out task safely, and job aids (if any) to enable him to do this	Maximum of 5.5 times

HEART – Human Error Assessment and Reduction Technique

11	**Performance requirement unclear**	Maximum of 5 times
12	**Misperception of risk**	Maximum of 4 times
13	**Poor feedback**	Maximum of 4 times
14	**Delayed / incomplete feedback**	Maximum of 4 times
15	**Inexperience**	Maximum of 3 times
16	**Poor information from procedures**	Maximum of 3 times
17	**Inadequate Checking**	Maximum of 3 times
18	**Conflict of objectives**	Maximum of 2.5 times
19	**No second way of confirming information**	Maximum of 2.5 times
20	**Education level of operator too high or too low for task**	Maximum of 2 times
21	**Incentive to use more dangerous procedures**	Maximum of 2 times
22	**Little opportunity to exercise mind within confines of job**	Maximum of 1.8 times
23	**Unreliable instruments – operator loses confidence**	Maximum of 1.6 times
24	**Operator has to make judgements outside his understanding or experience**	Maximum of 1.6 times

HEART – Human Error Assessment and Reduction Technique

25	**Unclear allocation of responsibilities and functions**	Maximum of 1.6 times
26	**No clear way of keeping track of progress during a task**	Maximum of 1.4 times
27	**Risk that operator's physical capabilities will be exceeded**	Maximum of 1.4 times
28	**Little or no intrinsic meaning in task – operator dispirited**	Maximum of 1.4 times
29	**High level of emotional stress, noise and other stress raisers**	Maximum of 1.3 times
30	**Ill-health – operator suffering from cold, flu or other ailment**	Maximum of 1.2 times
31	**Low morale among operating staff – cause complacency**	Maximum of 1.2 times
32	**Inconsistency between different displays to operator**	Maximum of 1.2 times
33	**Poor work environment**	Maximum of 1.15 times
34	**Prolonged inactivity or repetitive task, low mental activity**	Maximum of 1.1 times
35	**Disruption of normal work-sleep cycles beyond normal shift patterns**	Maximum of 1.1 times
36	**Task pacing by intervention of others rather than working at own pace**	Maximum of 1.06 times
37	**Additional team members present over and above normal team**	Maximum of 1.03 times
38	**Age of personnel performing perceptual tasks**	Maximum of 1.02 times

HEART – Human Error Assessment and Reduction Technique

- Assessment carried out by a small team, including the person who normally carries out the task

- Procedure is carried out in four stages:-
  1 defining the task to be analysed
  2 identifying the critical task situation and the types of error
  3 assessment of the Error Producing Conditions, quantifying if necessary.
  4 defining the error reduction measures required

- Several assessments carried out on existing operations
- Take 1 to 2 hours per assessment
- Agreement with observed error rates good
- Useful error-reducing ideas generated.