# HUMAN FACTORS

BRIEFING NOTE No. 12

# Human error and non-compliance

We rely on human operators to reliably perform the tasks they are best suited to in human-machine systems. Examples include physical manipulation of tools and components in maintenance tasks, or problem-solving in troubleshooting tasks. However, humans will make errors – errors of judgment, mistakes, etc. The management of human reliability is therefore the management of human failure.

## Why human error and non-compliance?

'Human error' is often cited as a cause of incidents in investigations, but in reality there are different types of human error, collectively described as human failure. The different types of human failure themselves have different causes and require different types of remedial action. It immediately becomes clear, then, that 'human error' by itself has little meaning when cited as a cause of an incident, and in order to address human failure issues, including both errors and non-compliances, it is important to recognise the different types of human behaviour and human failure, and why they take place. The means of eliminating or reducing one type of failure will not necessarily work for other types of failure.

## Has your company had any of these problems?

| If the answer to any of the following questions is 'Yes', then you should take action! | Yes | No |
|---|---|---|
| 1. Are items of equipment poorly-designed and laid out so that it is easy, for example, to operate the wrong control or read the wrong display? | | |
| 2. If someone made an error, would they be unable to detect the error from plant indications or behaviour of the system? | | |
| 3. Would there be little or no time to correct an error before any harm was done? | | |
| 4. Are tasks poorly-designed so that there is no time to stop, think and check before acting or attention is divided between several tasks at once? | | |
| 5. Do some tasks entail remembering complex items of information – e.g. how to do something you have not done for some time, or remembering to do something later – but there are no checklists or job aids for this? | | |
| 6. In unusual situations, especially where problem-solving and decision-making are needed, are operators ill-equipped to deal with this because of a lack of suitable training, job aids, competent assistance from other team members, or a helpline? | | |
| 7. Is it difficult to obey all rules and regulations and still get the job done (too many rules to learn or remember)? | | |
| 8. If anyone did break a rule or regulation, is it very unlikely that they would be found out and punished? | | |
| 9. Is it often more convenient, less trouble or quicker to break rules, regulations or procedures than to follow them? | | |

# Types of human behaviour


From direct observation of people at work it has been found that we show three different types of behaviour in carrying out industrial tasks. They are: 'skill', 'rule' and 'knowledge-based' behaviour, and they differ from each other in the level of conscious effort we apply to them.

## Skill-based level

Tasks are simple and routine; they are things we have carried out many times before. Attention required for the task is minimal – we are effectively on autopilot, though we do carry out basic checks on our progress with the task from time to time – e.g. 'still on target? Carry on'; 'not on target? – make an adjustment'. The checks themselves are largely unconscious. Driving a car is a good example of this. Problems occur when the attention required for checking is diverted.

## Rule-based level

We apply rules to the task that either help to work through a problem or to identify the correct action to take. A rule-based diagnosis task would be where we apply a rule of the form 'if this, then that': for example, 'if power is reaching the lamp but it is not lighting, then the bulb is faulty'. A rule-based action task is of the form 'if this, then do this': for example, 'if the temperature in vessel X has reached 85 °C, then switch steam heating to half power'. The rules in this case may be stored in our memory or in the form of written instructions. Problems occur if we forget part of the rule or, through inattention, miss a step in a written instruction or apply the wrong rule.

## Knowledge-based level

We need to apply significant conscious effort, usually in problem solving or troubleshooting tasks when our rules no longer apply. For example, a tanker driver filling a compartment at a depot expects to load 4 500 litres of product. At 3 400 litres, loading stops. The driver realises that the overfill protection system has activated. His immediate thoughts are that either: the compartment was partially full when he began filling – but he checked all sight glasses beforehand – so possibly the overfill probe is faulty; or, the filling pump has failed. Without making further checks he does not know which of these diagnoses, if any, is correct. The problem is that he may take action – such as overriding the protection system – without further checking.

# Types of human failure

The types of human behaviour described above can lead to different types of human failure, divided into 'errors' and 'violations'.

## Errors

Unintended actions or consequences, fall into categories of 'slips', 'lapses' and 'mistakes' (or 'cognitive errors').

A slip is where a process and its implementation are familiar, but result in performance failure. For example, the task could be to close circuit breaker A, however circuit breaker B is closed instead because it is identical to and next to A. In this case, the operator simply overreaches, and may not even look at 'A' or read its label. This is because the operator typically feels for the control (rather than: looking at it, checking it is the right one and making a conscious choice to operate that control).

A lapse is a lapse of attention or memory – failing to do something because it had been forgotten, or the operator had missed a a step in a sequence of actions through momentary distraction.

A mistake can be a rule-based mistake – a rule is incorrectly applied to the current situation because it is similar to another situation that the rule does apply to. Or it can be a knowledge-based mistake – a solution to a problem is devised based on knowledge, experience and a 'mental model' of how the system works. The problem here is we are prone to numerous forms of bias in situations of uncertainty. We make assumptions, settle for the first diagnosis we come up with, reject information that doesn't support that diagnosis, etc., and then take action based on that. This can make the situation more complex and more difficult to diagnose when the action fails to deliver the result we expected, or it can lead straight to system failure.

Mobile phone use below road tanker unloading gasoline. Courtesy of http://www.safteng.net/

## Violations

Violation (or non-compliance) differs from an error in that it is a deliberate action taken by someone who knows it is incorrect/against procedures or rules. Non-compliances are not simply malicious behaviours; most can be explained as entirely rational responses to working arrangements. Current thinking is that there are six types of non-compliance:

1. Unintentional – breaking a rule because it has been misunderstood or misinterpreted.
2. Situational – it is not possible to get the job done by following the rules strictly.
3. Exceptional – deviation from rules under unusual circumstances.
4. Organisational benefit – breaking the rules for the (real or assumed) benefit of the employer.
5. Personal benefit – there is some reward for the individual – it is less effort, faster or more exciting to break the rules.
6. Reckless – breaking rules despite known dangers to self and others.

The problem with non-compliances is that they involve making a judgement about the risk involved. If this judgement is incorrect, the results can be disastrous.

Human failures, then, are the result of what was planned and what actually happened. Examples of the main types are shown below (a full list of human failure types and a presentation on the subject can be found in Reference 1).

| What was planned | | What actually happened | | Result |
|---|---|---|---|---|
| Correct | + | Correct | → | Success |
| Correct | + | Incorrect – an action was omitted/incorrect | → | Slip or lapse |
| Incorrect – unaware that it was incorrect/contrary to procedures | + | As planned | → | Mistake/unintentional non-compliance |
| Incorrect – aware that it was incorrect/contrary to procedures | + | As planned | → | An intentional non-compliance |

# What should my company do about it?

## Management responsibility

Understanding behaviours, errors and non-compliances is no longer an advanced human factors subject, as these are now described in many health and safety publications. Management should therefore be aware of the ways that all human failures can occur – especially in safety critical tasks – and recognise the measures required to reduce or prevent them. Specialist help may be needed to provide guidance on the key issues of human reliability, but the primary means of improvement are via good hazard assessment and risk control practices.

## Improving reliability

Errors are by definition unintentional, and non-compliances usually occur in an attempt to solve problems, not cause them. Thus, advising people to be more careful, or wholesale threatening of sanctions for rule-breaking, are ineffective. The table below describes more suitable means for reducing human failure and its effects.

| Failure type | Possible remedies – ensure that… |
|---|---|
| All | • Personnel are highly competent in all tasks<br>• Systems can tolerate human failures – are resistant to failure or allow recovery<br>• Problems can be freely reported and discussed |
| Slip | • Controls that are vulnerable to inadvertent operation are protected<br>• Displays are well-designed and critical readings are checked<br>• Workloads are optimal – neither too demanding nor too routine/repetitive<br>• Systems provide timely feedback on errors and allow recovery<br>• Critical tasks include stopping and checking points to prevent 'autopilot' problems |
| Lapse | • Checklists are available and used to keep track of key task elements<br>• Tasks are evenly paced with minimal time pressure – no requirement to rush<br>• Distractions from other tasks and co-workers are minimised<br>• Refresher training is provided to maintain competence and familiarity with systems |
| Mistake | • Personnel are trained in problem-solving and decision-making<br>• Difficult tasks are reduced, where possible and without making them tedious, to simpler (rule-based) tasks supported by clear procedures<br>• Decision makers have time to consult key information sources – including colleagues – to verify that a particular rule or diagnosis is valid before taking action |
| Non-compliance | • Rules and procedures and the reason for them is clear to everyone<br>• The consequences of breaking critical task procedures – including disciplinary action where appropriate – are clear to everyone<br>• Procedures are logical, consistent (in design and application and do not conflict with each other) and are achievable<br>• Personnel understand that they should report problems with procedures and tasks rather than work around them<br>• Personnel are clear as to their supervisors' and the organisation's expectations for achieving goals and how they are to be achieved within current rules and procedures |

## Culture

The remedies above will be effective only if the organisation's culture supports them. Managers and workforce should communicate well with each other and trust each other, and should not inadvertently create a culture of rule breaking. In the absence of a good safety culture, routine and regular failures are likely to occur as design, procedural and competence problems go unreported and uncorrected. See Briefing note 9 *Safety culture*.

## References


1. Energy Institute (2009), *Human failures types*, http://www.energyinst.org.uk/humanfactors.


## Further reading


- Rail safety and Standards Board (2004), *Project T145: Safety critical rule compliance*, report and toolkit on website: http://www.rssb.co.uk/.
- Reason, J. (2008), *The Human Contribution*, Ashgate Publishing.
- HSE (2002), *Techniques for addressing rule violations in the offshore industries,* HSE Offshore Technology Report OTO 00096, HSE Books.
- Reason, J.T. (1990), *Human error*, Cambridge University Press.
- Hearts and Minds toolkit: *Managing rule breaking*, available from http://www.eimicrosites.org/heartsandminds


For background information on this resource pack, please see Briefing note 1 *Introduction*.