Understanding Human Failure

Human Failure

Incident Causation

It is now generally accepted that human failure is a significant factor in incident causation. Many incidents, if not most, are the result of a human error or violation. In this context the HSE recently has stated that, "studies have shown that up to 90% of accidents are attributable to human failures".

If those involved in managing how people behave are to be successful, then they ought to have some knowledge as to the nature and process of human failure and the factors that influence it.

Human Factors

There is an increasing emphasis on human factors in the management of safety – especially in the higher hazard industries. *Human factors* is a generic term concerned with how people learn, think and behave, and how these are influenced or affected by the variety of events that surround us. The following model is taken from HSG48 and serves to highlight the three main areas to focus on in terms of what determines how we behave.

(HSE (1999) **Reducing Error and Influencing Behaviour** (HSG48).

Published by HSE Books ISBN 0-7176-2452-8).

- **Individual**: our skills, preferences, personality, personal situation
- **The job**: task demands, process complexity, working conditions
- **The organisation**: management, climate, culture

Each of these interacts with the others to produce the behaviours that we see. Most of the time, things go relatively smoothly and incidents are avoided. Occasionally, and typically as a result of a change in one or more factors, things go wrong and if uncontrolled can lead to an unplanned and unwanted event.

Focus on the individual

In this document we are mostly concerned with looking at how the individual performs but as we will see we will also include a focus on some of the environmental factors that influence this. This is not intended to suggest that the individual is the most important aspect to focus on – generally incidents are best explained by a consideration of an interaction of a wide variety of issues (individual, job and individual). However, with respect to management, an understanding of human failure in the context of individual factors is important. Effective managers will always have an eye on the potential for human failure and having a sensitivity as to where and how things might go wrong is important in this.

Errors and Violations

There are two distinct categories of human failure: errors and violations. Whilst these are quite distinct, they are not necessarily mutually exclusive. As we have already indicated, incidents are often the result of a dynamic interaction of a variety of acts and events. In effect, any one incident may involve both errors and violations. Despite this, some understanding of each of these can be useful. (HSG48 provides a useful guide to this area.).

Errors and violations can both result in incident events, although even with violations there is rarely an intention to cause such an outcome. Nevertheless, the distinction between errors and violations is often made with respect to the degree of intentionality. People do not intend to create an error or make a mistake, whereas people do indeed choose to ignore (violate) rules and procedures. Because of this, errors are often described as being unintentional whereas violations are intentional.

Errors

Errors are generally unintentional in the sense that we do not mean to slip up or make a mistake. Errors result from our inherent inadequacies with respect to cognitive storage, retrieval and processing of information. From time to time, we all get things wrong – none of us are perfect; we are all error prone to one degree or another. Individual differences suggest that some people are more error prone, although we need to be careful here as it is not necessarily unusual for the most safety conscious person to be involved in an incident.

Violations

Violations are intentional in the sense that they result from some conscious choice to act in one way in preference to another and the choice represents a deviation from a rule, procedure or accepted best practice. In a sense, violations could be regarded as *unnecessary* risks. However, we should not assume from this that violations are indicative of a deviant character. There are times for example when a worker may take a short cut in order to achieve some important business targets – in such cases the choice results from trying to do a good job for the company.
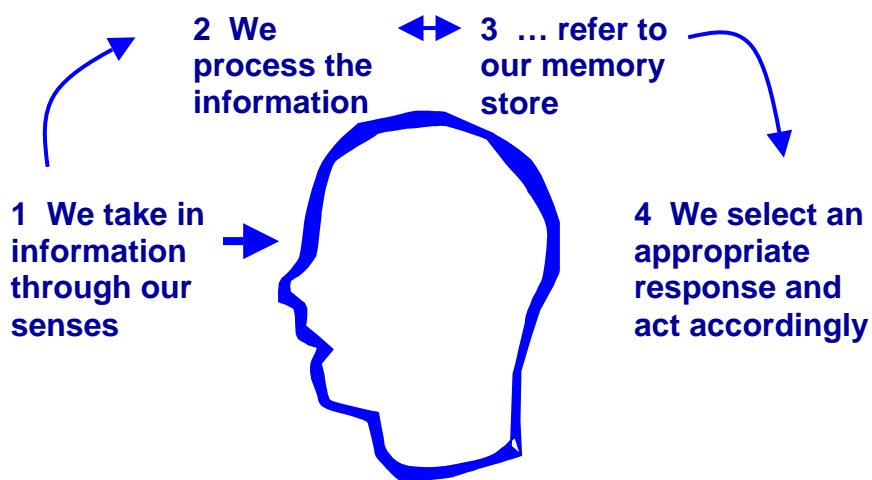
Tackling Human Failure

Reducing the human failure potential through the eradication of both errors and violations is important – both are problems that we need to manage. In this document we are concerned particularly with error management.

Human Error

Information Processing

Errors result because of the finite capacities we have in relation to information processing. Problems can be associated with our intake of information (perception), information retrieval (memory), analysis and processing (decision making), and our choice of response (action). Together these make up the process through which choose to behave in a certain way.

2 We process the information ↔ **3 … refer to our memory store**

1 We take in information through our senses

4 We select an appropriate response and act accordingly

Perception: relates to the intake of information and is affected by the information the person is aware of and that which he / she chooses to focus on. (Error possibility: may not be aware of some important event / item of information)

Memory: to do with the storage of information and learning, and the retrieving of important facts and knowledge. (Error possibility: forgets important piece of information, remembers critical information but in the wrong order)

Decision: the processing of information, applying learnt rules, problem solving etc. (Error possibility: links issues in the wrong way, comes to the wrong conclusion when weighing up facts available)

Action: what the person does following the processing of the information. (Error possibility: chooses the wrong action, intends to do one thing but does something else due to distraction)

Error may result from a deficiency in any of the above or a combination of them.

Attention

A critical factor is a person's ability to maintain the required level of vigilance and attention. Our ability to maintain attention is limited – studies of radar operators found that there was a significant drop in performance after about 20 minutes. Our ability to attend is affected by length of time, interest level of what is being observed, other distracting / competing information etc. In the context of safety, the longer and more often a person is involved in doing a task, this less likely they will be to attend to the critical issues. In effect they become desensitised to the risks and the result is a loss of focus.

Familiarity

As indicated above, the novelty of the task is a further factor. Novel tasks place demands on our database of knowledge and our ability to problem solve. This is in contrast to the demands associated with more familiar and frequent tasks, where the issue is more to do with maintaining vigilance and attention.

Novel tasks typically require more conscious and active processing – errors occur in the form of *mistakes*

Familiar tasks are typically dealt with by using well-learnt and automatic routines – errors occur in the form of *slips and lapses*

Error Types

The work of Jens Rasmussen is particularly well known in this area. Rasmussen has identified 3 distinct modes of operating: skill-based, rule-based and knowledge-based. These relate both to the type of task (novel or familiar) and level of conscious processing (conscious or automatic).

Skill-based: highly learned behaviour that occurs almost without thinking – like driving a car.

Rule-based: problem-solving behaviour based on applying well known rules - if I am driving on the continent, then I know that I need to raise my awareness to ensure that I counter the normal tendency to drive on the left

Knowledge-based: novel situations requiring new knowledge and skills – learning how to fly a helicopter (for most of us)

Each of these can result in human error events:

Error types   - **skill-based** (slips and lapses, associated with highly learnt / automatic type actions – "silly mistakes")

- **rule-based** (mistakes of the sort where an established rule or principle is misapplied, or where a bad rule is used)

- **knowledge-based** (mistakes associated with a lack of knowledge)

Error Provoking Factors

These are conditions that can have an effect on human performance and lead to variations in how the person normally performs (eg fatigue associated with the rota / shift patterns). They are sometimes referred to as performance shaping factors. They can explain why a person suddenly acted "out of character". They can be extremely important in understanding accident and

incident causation. The task is to try and promote the positive performance shaping factors and exclude those that have negative effects.

Some examples of error-provoking factors are set out below:

- **Team beliefs**
- **Time pressure**
- **Hazard awareness**
- **Unworkable procedures**
- **Equipment availability**
- **"Can do" attitudes**
- **Demographics**
- **Documentation**
- **Technical support**
- **Unsuitable tools**
- **Sleepiness**
- **Circadian low points**
- **Poor communication**
- **Shift handovers**
- **Inexperience**
- **Task frequency**
- **Design deficiencies**
- **Housekeeping**
- **Tool control**

Common Types of Failure

Experience has taught us that there are some common types of human failure events – of course these do not always lead to an accident or incident but they increase the likelihood of such events:

- **Recognition failures**
- **Memory lapses**
- **Slips of action**
- **Errors of habit**
- **Mistaken assumptions**
- **Lack of knowledge**
- **Violations**

Recognition failures

- **Similar information**
- **Poor illumination, too much "noise"**
- **We see what we expect to see**
- **Over-familiarity – lack of attention to detail**

These occur when we misread information or fail to detect important information – they are therefore to do with our perception or intake of information.

Memory lapse

- **Forgetting whether you have just done something**
- **Make mental note to do something then forget**
- **Know you know – but just can't remember ("tip of my tongue")**

These involve problems with both our short-term and long-term memory.

Slips of action

- **Interruption during activity leads to actions getting left out (return to task at wrong place in sequence)**
- **Thinking ahead can mean jumping ahead before task is completed**

As implied, this is where we "slip up" – we miss out an important step, or do things in the wrong order etc.). (A type of skill-based error).

Errors of habit

- **Sub-consciously slip in to a well learnt routine which in this case is not what you intended to and not appropriate – habit takes over**

This relates to situations where autopilot takes over but in the wrong situation. (Eg driving "home" – end up at old house following a recent move – still thinking about an important situation at work and so not fully concentrating). (A type of skill-based error).

Mistaken assumptions

- **Make an assumption that the current situation is like others and apply a learnt rule inappropriately**
- **Apply a "bad rule" to get the job done believing it will be OK**

These are "rule-based errors – we wrongly apply problem-solving (if this, then that) based on other experiences and established learning.

Lack of knowledge

- **Needing to find new information to address a situation, error results from incomplete or faulty knowledge**

These occur when we are faced with new or novel situations – we may act thinking we have all the knowledge we need but this is not correct and a "knowledge-based error" is the result.

Violations

- **Personal gain (avoid extra work)**
- **Custom and practice – how things are done round here**
- **Improvising to meet needs of situation**
- **Acting in exceptional circumstances**

Most violations are "situational violations" – a rule has been broken as a result of some error-provoking factor (such as perceived time pressures).

Managing Error

Error has the potential to affect performance, quality and safety. Much of how we go about managing the workplace, through quality assurance and control systems and safety management systems, includes a focus of reducing or even eliminating error probability. However, James Reason (see reference below) lists a number of characteristics that differentiate error management from quality and safety management systems. These are as follows:

Effective error management:

- Is more about the achieving **the right mind-set** than it is about having a formal documented system

- Assumes that **things will go wrong** – "takes Murphy's Law as its starting point"

- Requires an **understanding of human error** – error types and the factors that make them more likely

- Requires **an "informed culture"** with a variety of means to capture knowledge

- Will not be achieved by simply introducing and relying on a set of error related tools – surveillance will always be required and one challenge is to make this something that people demand to protect themselves rather than something seen as an indicator of mistrust.

Much of the above has been adapted from the following book:

James Reason and Alan Hobbs (2003) **Managing Maintenance Error: A Practical Guide.**
Published by Ashgate Publishing Ltd ISBN 0-7546-1591-X

For those in search of an advanced book on the subject of human failure, the following is recommended:

James Reason (1990) **Human Error.**

Published by Cambridge Univ Press ISBN 0-521-31419-4