



# postnote

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## MANAGING HUMAN ERROR

The recent (June 2001) publication of the Cullen Report into the Paddington rail crash has once more focused media and public attention on large-scale accidents. Such incidents are often followed by calls for blame to be allocated to individuals at the 'sharp end' of the industry in question. In addition, small-scale workplace accidents account for over 200 deaths per year and over 180,000 injuries. This briefing looks at human factors which are liable to cause such errors, examines how their effects can be minimised and analyses the implications for health and safety policy.

### Background

It has been estimated that up to 90% of all workplace accidents have human error as a cause<sup>1</sup>. Human error was a factor in almost all the highly publicised accidents in recent memory, including the Bhopal pesticide plant explosion, Hillsborough football stadium disaster, Paddington and Southall rail crashes, capsizing of the Herald of Free Enterprise, Chernobyl and Three-Mile Island incidents and the Challenger Shuttle disaster. In addition to these acute disasters some industries, notably health-care, experience long-term, continuous exposure to human error. The costs in terms of human life and money are high<sup>2</sup>. Placing emphasis on reducing human error may help reduce these costs.

### Limitations of human behaviour

In order to address human factors in workplace safety settings, peoples' capabilities and limitations must first be understood. The modern working environment is very different to the settings that humans have evolved to deal with. This section examines human characteristics that can lead to difficulties interacting with the working environment. The box on page 2 provide details on the main factors involved, including:

- Attention - the modern workplace can 'overload' human attention with enormous amounts of information, far in excess of that encountered in the natural world. The way in which we learn information can help reduce demands on our attention, but can sometimes create further problems (e.g. the Automatic Warning System on UK trains, see box on page 2).
- Perception - in order to interact safely with the world, we must correctly perceive it and the dangers it holds. Work environments often challenge human perception systems and information can be misinterpreted.
- Memory - our capacity for remembering things and the methods we impose upon ourselves to access information often put undue pressure on us. Increasing knowledge about a subject or process allows us to retain more information relating to it.
- Logical reasoning - failures in reasoning and decision making can have severe implications for complex systems such as chemical plants, and for tasks like maintenance and planning.

### Addressing human error

The types of problems caused by these factors are often unavoidable. In certain situations, human beings will always make mistakes, and there is a limit to what can be done to modify behaviour itself. However, there are other methods of dealing with human error, and these are discussed in more detail in this section.

As it is inevitable that errors will be made, the focus of error management is placed on reducing the chance of these errors occurring and on minimising the impact of any errors that do occur. In large-scale disasters, the oft-cited cause of 'human error' is usually taken to be synonymous with 'operator error' but a

## Human characteristics and the working environment

### Attention

Attention on a task can only be sustained for a fairly short period of time, depending on the specifications of the task. The usual figure cited is around 20 minutes, after which, fatigue sets in and errors are more likely to occur. This is why air traffic controllers are obliged to take breaks from their attention-intensive work at regular intervals. However, there are a number of other reasons why the attentional system is responsible for errors. These include:

- Information bottleneck – it is only possible to pay attention to a small number of tasks at once. For example, if an air traffic controller is focussed on handling a particular plane, then it is likely that they will be less attentive to other aspects of safety, or other warning signals (although this depends on the nature of the signal).
- Habit forming - if a task is repeated often enough, we become able to do it without conscious supervision, although this 'automatisation' of regular and repetitive behaviour can force us into mistakes. In 1979, an operator at Oyster Creek Nuclear Power Plant intended to close off two pump discharge valves. Through an attentional slip, he accidentally closed off two other valves as well, and in doing so, closed off all circulation to the reactor core.

The **Automatic Warning System** installed on all passenger trains in the UK is an example of a system that was not designed with limitations of human attention in mind. It is a device fitted in the train cab, based on the now obsolete mechanical system of signalling that used to signal either STOP or PROCEED. It sounds a bell when a clear (green) signal is passed and a buzzer when caution or danger is signalled. If the buzzer is not acknowledged by the press of a button, then the train begins to stop automatically. In commuter traffic, most signals will be at the 'caution' aspect, and given the frequency of signals (spaced 1km apart), most drivers will face two signals per minute. Given the tendency for the attentional system to automate highly repetitive behaviour, many drivers lose focus on the reasons for carrying out this repetitive task, and act in reflex whenever the buzzer sounds. The end result is that drivers often hear the buzzer and press the button reflexively without actively thinking about train speed and location.

Source: Davies, D. (2000): *Automatic Train Protection for the Railway Network in Britain – A study*. RA Eng., London.

### Perception

*Interpreting the senses* - one of the biggest obstacles we face in perceiving the world is that we are forced to *interpret* information we sense, rather than access it directly. The more visual information available to the perceiver, the less likely it is that errors will be made. Bearing this in mind, systems that include redundant information in their design may cause fewer accidents. An example of this was the change in electrical earth wire colour coding in the 1970's to include not only colour, but also a striped pattern.

*Signal detection* - the more intense a stimulus (such as a light or a noise), the more powerful the response elicited (such as brain activity or a physical movement). This has implications for the way danger signals are perceived at work. For instance, the order in which the severity of danger is signalled on UK rail tracks is single red (most dangerous), followed by single yellow, then double yellow and finally green (no danger). Research suggests there may be some merit in swapping the order of the yellow signals, as the double yellow is more intense and thus more noticeable than the single yellow signal. However, this point must be offset against the fact that the current system provides automatic mechanical failsafe if a yellow bulb blows, and the psychological notion that double yellow serves a useful role as a countdown to the single.

### Memory

*Capacity* - short-term memory has an extremely limited capacity. In general, people can remember no more than around seven individual items at a time. This has safety implications in areas such as giving new workers a set of instructions to follow from memory or attempting to remember the correct sequence of procedures within a new task. However, trained individuals are able to retain larger chunks of information in memory. For example, chess grandmasters can remember the location of more pieces on a chessboard than can a novice because they see the pieces not as single units, but as parts of larger conceptual units which form coherent wholes.

*Accessibility* - even when items are stored in memory, it is sometimes difficult to access them. There has been much research into the ways in which recall of information can be improved. For example, research has shown that people are much more likely to remember information if they are in similar conditions to when they encoded the information. This was illustrated in a study involving divers who were given lists of words to learn on dry land and underwater. Words learned on the surface were best recalled on the surface, and those learned underwater best recalled underwater. This has implications for training programmes, where albeit under less extremely contrasting situations, staff trained in an office environment may not be able to remember relevant details on the shop floor.

*Levels of processing* - another way in which information can be more reliably remembered is to learn it at greater depth. For instance, if it is necessary to remember lists of medical symptoms, then it helps to understand more about the conceptual framework behind the list. If only the 'surface' features (such as the words on the list) are remembered, then there is a higher chance of information being forgotten.

Sources: Chase, W.G. & Simon, H.A. (1973): *Perception in chess*. *Cognitive Psychology*, 4: 55-81.

Tulving, E. (1979): *Relation between encoding specificity and levels of processing*. In, L.S. Cernak & F.I.M. Craik (Eds.), *Levels of processing in human memory*. Hillsdale, N.J.:Lawrence Erlbaum.

### Logical reasoning

Humans are not very good at thinking logically, but in technological situations, logical procedures are often necessary (for example, troubleshooting a complex system which has broken down). Illogical behaviour is a common source of error in industry. During the Three Mile Island incident in 1979, two valves which should have been open were blocked shut. The operators incorrectly deduced that they were in fact open, by making an illogical assumption about the instrument display panel. The display for the valves in question merely showed that they had been instructed to be opened, whereas the operators took this feedback as an indication that they were actually open. Following this, all other signs of impending disaster were misinterpreted with reference to the incorrect assumption, and many of the attempts to reduce the danger were counterproductive, resulting in further core damage.

measure of responsibility often lies with system designers. For instance, during the Second World War, designers attempted to introduce a new cockpit design for Spitfire planes. During training, the new scheme worked well, but under the stressful conditions of a dogfight, the pilots had a tendency to accidentally bail out. The problem was that the designers had switched the positions of the trigger and ejector controls; in the heat of battle, the stronger, older responses resurfaced.

Recent research<sup>3,4</sup> has addressed the problem of how to design systems for improved safety. In most safety-critical industries, a number of checks and controls are in place to minimise the chance of errors occurring. For a disaster to occur, there must be a conjunction of oversights and errors across all the different levels within an organisation. This is shown in the figure below from which it is clear that the chances of an accident occurring can be made smaller by narrowing the windows of accident opportunity at each stage of the process. Factors such as training and competence assurance, management of fatigue-induced errors and control of workload can eliminate some errors. But errors caused by human limitations and/or environmental unpredictability are best reduced through improving system interface design and safety culture.

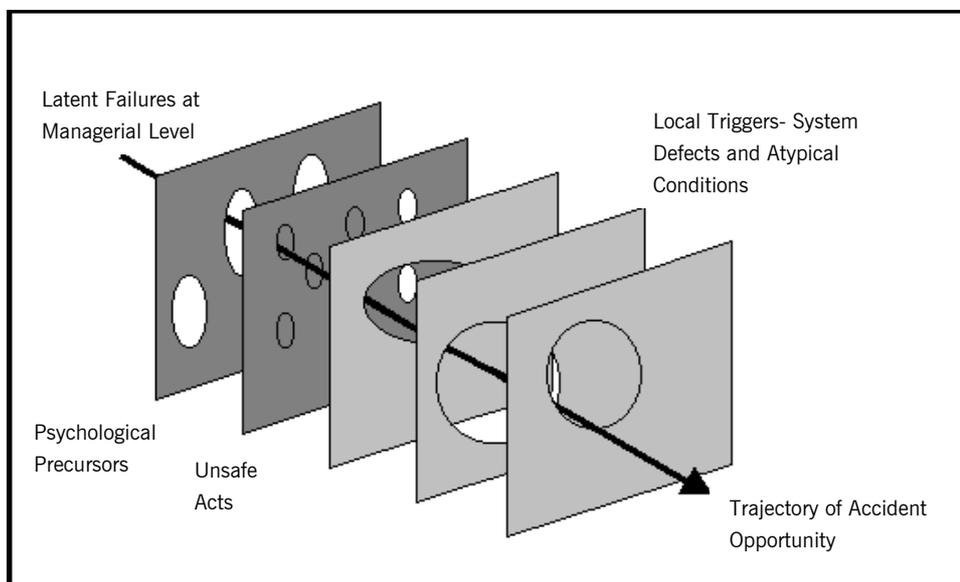
### System design

A good system should not allow people to make mistakes easily. This may sound obvious, but all too commonly system design is carried out in the absence of feedback from its potential users which increases the chance that the users will not be able to interact correctly with the system. A set of design principles has been proposed<sup>4</sup> which can minimise the potential for error. These are discussed below.

### Accurate mental models

There is often a discrepancy between the state of a system and the user's mental model of it. This common cause of erroneous behaviour arises because the user's model of the system and the system itself will differ to some extent, since the user is rarely the designer of the system. Problems that can arise as a result of this discrepancy are illustrated by the Three Mile Island incident cited in the box on page 2. In this incident, the system had been designed so that the display showed whether the valves had been *instructed* to be open or closed. The most obvious interpretation to the user was that the display reflected the *actual status* of the system. Designers need to exploit the natural mappings between the system and the expectations and intentions of the user.

### The Swiss cheese model of accident causation



The figure shows a trajectory of accident opportunity and its penetration through several types of defensive system. The combined chances of an accident occurring are very small, as the holes in the various defence systems must all line up. Some are active failures of human or mechanical performance, and others are latent conditions, such as management factors or poor system design. However, it is clear that if steps are taken in each case to reduce the defensive gaps, the overall chance of accident will be greatly reduced. Organisational planning can reduce the latent failures at the managerial level, psychological failings can be reduced by paying attention to the types of task that are required of workers and unsafe acts can be reduced by good interface design.

Source: Reason, J. (2000): *Human error: Models and management*. *British Medical Journal*, **320**: 768-770.

Another example of the importance of user familiarity with the working system is demonstrated by a laboratory study which examined how useful it was to give staff an overview of a fictitious petrochemical plant's structure and day-to-day functioning. One group was given rules about which buttons to press if a dangerous situation arose; another was given the rules and an overview of the workings of the plant. Both groups were equal in their ability to deal with the expected problems, but when new problems arose, only the group which understood the plant's functioning were able to deal with the situation<sup>5</sup>.

#### *Managing information*

As our brains are easily distracted and can overlook necessary tasks, it makes sense to put information in the environment which will help us carry out complex tasks. For example, omission of steps in maintenance tasks is cited as a substantial cause of nuclear power plant incidents<sup>6</sup>. When under time pressure, technicians are likely to forget to perform tasks such as replacing nuts and bolts. A very simple solution to this problem would be to require technicians to carry a hand-held computer with an interactive maintenance checklist which specifically required the technician to acknowledge that certain stages of the job had been completed. It could also provide information on task specifications if necessary. This would also allow a reduction in paperwork and hence in time pressure.

#### *Reducing complexity*

Making the structure of tasks as simple as possible can avoid overloading the psychological processes outlined previously. The more complex the task specifications, the more chances for human error. Health-care systems in the US are currently addressing this issue. With the realisation that a leading cause of medical error in the United States was related to errors in prescribing drugs, a programme was undertaken to analyse and address the root causes of the problem. A computerised system of drug selection and bar-coding reduced the load on memory and knowledge on the part of the prescriber, and errors of interpretation on the part of the dispenser, resulting in an overall reduction in prescription errors. Examples such as this emphasise the fact that reducing task complexity reduces the chance of accidents.

#### *Visibility*

The user must be able to perceive what actions are possible in a system and furthermore, what actions are desirable. This reduces demands on mental resources in choosing between a range of possible actions. Perhaps even more important is good quality feedback which allows users to judge how effective their actions have been and what new state the system is in as a result of those actions. An example of poor feedback occurred during the Three Mile Island incident; a poorly-designed temperature gauge was consistently misread by experienced operators (they read 285 degrees Fahrenheit as 235 degrees), which led them to underestimate the severity of the situation.

#### *Constraining behaviour*

If a system could prevent a user from performing any action which could be dangerous, then no accidents would occur. However, the real world offers too complex an environment for such a simplistic solution: in an industrial operation, a procedure which could be beneficial at one stage in the process may be disastrous at another. Nevertheless, it is possible to reduce human error by careful application of 'forcing functions'. A good example of a forcing function is found in the design of early cash machines. People used to insert their card, request cash, take it and walk away, leaving their cash card behind. It was a natural enough response, as the main objective of the action had been achieved: obtaining money. The task was thus mentally marked as being complete before all necessary stages of the transaction had been carried out. After a great deal of thought, the systems designers came up with a very simple solution which has been effective ever since: as the target objective of the task was to obtain money, placing this stage at the very end of the transaction would avoid the problem. Hence, the card is now given back before the money is. Functions such as this relieve the user of the responsibility of deciding what actions are appropriate whilst interacting with the system, and are very effective in preventing dangerous incidents.

#### *Design for errors*

In safety-critical systems, such as nuclear power plants, numerous safety systems are in place which can mitigate accidents. One approach is 'defence in depth' (implementing many independent systems simultaneously); another is 'fail-to safe state' system design. However, designers must assume that mistakes will occur, and so any useful system must make provision for recovery from these errors. Another consideration is that the design should make it difficult to enact non-reversible actions. Although this is an underlying principle of design, it needs to be applied carefully. For instance, most home computers have a 'recycle bin' or 'trash' folder, in which all deleted files are stored. They are recoverable from here, but when this folder is emptied, files cannot be recovered at all. Attempts to empty this folder result in a message asking the user to confirm deletion. The problem is that the user is often asked to confirm such requests, and, just like the train drivers with the AWS system (see box on page 2), learns to associate the appearance of the warning message with the pressing of the 'OK' button. The result is that the pop-up messages may not be read, and on occasion, files are accidentally destroyed. A safer option would be to use this type of pop-up box less regularly, and to require different user input each time.

#### *Standardisation*

When systems are necessarily complex but have been made as accessible and easy to use as possible and errors are still being made, then standardisation is sometimes used as an attempt to make the situation predictable. It has been suggested that medicine is one of the areas most amenable to standardisation. For instance, resuscitation units in accident and emergency

hospitals vary considerably in their design and operation. This diversity, coupled with the movement of staff between hospitals, mean that errors can be made and delays occur. Another example where standardisation might be of use in medicine is across different brands of equipment, since staff often do not have training in all the available designs. If all hospital equipment had standard placement and design, then all staff would be able to locate and operate equipment with ease.

One problem with standardisation is that if any advances in design or usage are made, then it is a very costly process to re-implement standardisation across all departments of an industry. Also, a standardised system may be ideal for one set of tasks, but very inefficient for another set. Such practical considerations have tended to limit the application of standardisation as an approach for reducing human errors.

#### *User-centred design*

Another basic principal of design is that it should be centred around the user at all stages from initial conception, through evolution and testing, to implementation. In practice however, systems designers are often given a brief, create the system and impose it upon the users without appropriate feedback. This can result in unexpected system behaviour and over-reliance on manuals which themselves have been written by the system designers from their own perspective. Systems designed in this way will be opaque to the end user, and this can hinder effective interaction. Designers of computer interfaces often fall into this trap.

#### **Safety Culture**

Attribution of accidents to human failures at the 'sharp end' of an industry may not provide a full picture of all the factors involved. The management of the organisation must also take responsibility for decisions which affect the safe functioning of the organisation as a whole<sup>7</sup>. Unwise decisions at this level are more difficult to link directly to an accident, as they are often implemented well before an accident occurs, and they do not make their presence urgently felt. Good decisions at this level can create a culture of safety which can remove the precursor conditions for accidents (see figure on page 3) or ameliorate their consequences.

*Safety Culture* is a term that was first introduced after the Chernobyl disaster in 1986. The safety culture of an organisation is the product of the individual and group values, attitudes, competencies and patterns of behaviour that determine the style and proficiency of an organisation's health and safety programmes. A positive safety culture is one in which shared perceptions of the importance of safety and confidence in preventative measures are experienced by all levels of an organisation. According to the Health and Safety Executive (HSE, the statutory body that ensures that risks to health and safety from work activities are properly controlled), factors that create this positive culture include:

- leadership and the commitment of the chief executive;
- a good line management system for managing safety;

- the involvement of all employees;
- effective communication and understood/agreed goals;
- good organisational learning/responsiveness to change;
- manifest attention to workplace safety and health;
- a questioning attitude and rigorous and prudent approach by all individuals.

If one or more of these factors is lacking, an organisation may be prone to corner-cutting, poor safety monitoring, and poor awareness of safety issues. In these settings, errors are common and disasters more probable. Impoverished safety culture contributed to major incidents such as the pesticide plant explosion at Bhopal in 1985, the Herald of Free Enterprise disaster (box, below) and a number of recent rail crashes (box, page 6). It has also been found that workers in poor safety cultures have a 'macho' attitude to breaking safety rules, and tend to ascribe the responsibility of safety to others.<sup>8</sup>

#### *Assessing safety culture*

Assessment of safety culture relies upon a safety auditing system. However, such approaches are 'top-down'

#### **The 'Herald of Free Enterprise' disaster**

The Herald of Free Enterprise capsized on the 6<sup>th</sup> March, 1987, killing ~200 people. It sank because its inner and outer bow doors had been left open on sailing, as a result of a combination of factors and decisions. The subsequent investigation found that all of these could have been avoided or ameliorated. Management failures set up a culture which compromised safety and allowed individual human errors to occur. Disaster could have been avoided if management had addressed safety in a more informed and committed way.

*Management Failures.* Management put pressure on crews to sail early by sending memos to staff demanding that ships leave 15 minutes early. To speed up sailing times, the chief officer, who was responsible for ensuring the bow doors were closed, was required to be on the bridge before sailing, rather than on the car loading deck. He was thus on the bridge before the cars had finished being loaded. It was the management's responsibility to ensure that a safe procedure was in place to prevent this type of omission. Another failure included orders that only 'negative reporting' should be employed; officers on board the ship were to assume that all was well unless they heard otherwise.

*Supervisory and Organisational Failure.* The assistant boson, whose job it was to actually close the doors was asleep in his cabin after a maintenance and cleaning shift. If more attention had been paid to rostering and monitoring staff, this would not have occurred. The boson left the deck without checking either that his assistant was on duty, or that the doors had been closed.

*System Design Failure.* Ship masters had repeatedly requested that bow door warning indicators be installed on the bridge, but management did not act on these requests. For an estimated £400, the equipment could have been installed and the ship's master would have known about the state of the doors before he left port. Other design failures included the top-heavy design of the ferry and inadequate equipment to remove water from the flooded deck.

Sources: Reason, J (1989): Human error. Cambridge, CUP.  
Sheen, B. (1987): Herald of Free Enterprise, Report of Court no. 8074 formal investigation. London.

methods, and may enumerate systems already in place, without necessarily assessing how effective they are. Performance indicators can also be used, with management experts setting target levels (often linked to bonus payments), which can have a negative effect on error reporting<sup>9</sup>. Such measures are not always an informative indication of safety performance: the shutting down of a reactor may be the result of human error or the result of human cautiousness. Research suggests that this kind of top-down approach be supplemented by assessments of the attitudes of staff toward safety, as it is their attitudes which determine behaviour.

For some industries there is evidence that achieving a positive safety culture through documenting accidents and investigating errors improves both efficiency and profitability. For instance, the US healthcare system, estimates that when litigation and take-up of hospital resources is taken into account, an effective error-reporting and handling system could save money<sup>10</sup>. Error reporting depends upon trust between hierarchical levels of the organisation, and it is suggested that incident reporting is itself an indicator of staff perceptions of managerial commitment to safety<sup>11</sup>.

Finally there is the question of ensuring that lessons are learned - and remembered - from accidents. Such experience may be lost to an organisation when members of staff leave or retire. One way of preserving it and making it more widely accessible is for industry sectors to pool information into computerised databases which can be searched by keywords as part of a risk assessment. One example of such an initiative is the Institution of Chemical Engineer's Accidents Database.

## Implementation

Previous sections have examined individual human limitations that make errors in the workplace inevitable. Research has shown ways in which good system design and organisational safety culture can help prevent errors from occurring and minimise the impact of those that do occur. This section outlines issues arising from the application of this knowledge to improving health and safety in the workplace. It examines specific legislative proposals as well as more general approaches building on the existing regulatory framework (outlined in the box on page 7) under the Government's 'Revitalising Health and Safety Strategy'. Launched in June 2000 by the HSC and the Government, this sets a number of targets to be achieved by 2010. These include reducing:

- working days lost from work-related injury and ill-health by 30% (from the current 97,000 days lost per 100,000 workers to 68,000 days per 100,000);
- work related ill health by 20% (from the current 1,400 to 1,120 new cases per 100,000 workers);
- fatalities and major injuries by 10% (from the current 260 to 230 cases per 100,000 workers).

### Corporate killing

Disasters such as the sinking of the Herald of Free Enterprise, the King's Cross fire, and the Southall and Clapham Junction rail disasters have all prompted calls

### Safety culture in the rail industry

The safety culture of an organisation depends on the degree of control it has over working practises and their consequences within the industry. Fragmentation of any such industry – whether through privatisation or other means – raises concerns over compromising safety. Privatisation of British Rail gave rise to over fifty franchises, with numerous sub-contractors having responsibility for sections of the railway. When plans for privatisation were first mooted, the Health and Safety Commission (1993) expressed concerns that safety might suffer as a result. Worries of increasing numbers of accidents were initially not borne out. However, following the recent spate of serious accidents, the debate has resurfaced and the safety culture of the rail industry is once again being scrutinised. Recent inquiries into the Hatfield, Southall and Paddington rail incidents implicate management failings as a factor, via under-investment in track maintenance, a lack of equipment and inadequate staffing levels. These, and other concerns are expected to be outlined in a report into the Hatfield rail crash, due to be published in July 2001.

Another concern is that while the *Railways (Safety Case) Regulations 1994* call for the active sharing of information between franchises, there is no specific requirement that errors be analysed at an industry-wide level. There was also concern from HSE that Railtrack, the company responsible for monitoring safety in the industry, did not focus on 'soft' measures, such as safety culture and human factors (although it now has human factor specialists in post).

Following recommendations by the Health and Safety Executive (HSE), Railtrack is adopting a new safety policy which includes the introduction of trials of a confidential incident reporting programme and the proposed creation of a safety intelligence centre within the Railtrack Safety and Standards Directorate (now Railway Safety Ltd). Initiatives such as this have been able to identify key danger areas, and suggest strategies for reducing the chances of an accident.

Sources: Clarke, S. (1998): Safety culture on the UK railway network. *Work and Stress* **12**: 285-292.  
HSC (1993): *Ensuring Safety on Britain's Railways*. HMSO. *Railway Group Safety Plan 2001/2002*. ([www.railwaysafety.org.uk/railplan0102.asp](http://www.railwaysafety.org.uk/railplan0102.asp))  
The Ladbroke Grove Rail Enquiry Report, HSC ([www.pixunlimited.co.uk/pdf/news/transport/ladbrokegrove.pdf](http://www.pixunlimited.co.uk/pdf/news/transport/ladbrokegrove.pdf))

for new legislation. In each case, subsequent inquiries found the corporate bodies at fault and criticised them severely. But in none of these cases was it possible to successfully prosecute the corporate bodies for manslaughter. This is because current UK law requires that before such a body can be convicted of manslaughter, an individual who can be "*identified as the embodiment of the company itself*" must first be shown to have been guilty of manslaughter.

In practice this is very difficult to achieve, particularly in large organisations with diffuse management structures and areas of responsibility. Indeed, there have only ever been three successful prosecutions of corporations for manslaughter in the UK; in each case, the corporations involved were small. This has led to a widespread perception that a new law dealing with corporate killing is required.

**Current regulatory framework**

The **Health and Safety Commission/Executive** are the regulatory bodies responsible for ensuring that risks encountered in the workplace are properly controlled. The Commission is responsible for securing the health, safety and welfare of persons at work and protecting the public generally against risks arising out of work activities. It sponsors research, promotes training and advises Ministers on all aspects of health and safety legislation. It also has general oversight of the work of the Health and Safety Executive (HSE). The Executive inspects workplaces, investigates accidents and ill health, enforces good standards, publishes guidance, advice and other information, and conducts research. Laws and regulations administered by the HSE include:

**The Health and Safety at Work Act 1974** is the foundation stone of British health and safety law. It sets out general duties which employers have towards employees and members of the public, and employees have to themselves and to each other. Such duties are qualified in the Act by the principle of “*so far as is reasonably practicable*” – i.e. the idea that the degree of risk needs to be balanced against the time, trouble, cost and physical difficulty of taking measures to avoid or reduce it. The law requires that the risks are evaluated and that sensible measures are taken to tackle them.

**Management of Health and Safety at Work Regulations 1992 (MHSWR)** - make more explicit what employers are required to do to manage health and safety under the Act. They require employers to conduct a risk assessment and adapt company safety policy accordingly.

**Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR)** - require employers to report some work-related accidents, diseases and dangerous occurrences. These include all deaths or major injuries, any other injury that leaves the employee off work for three days or more, any work-related disease and any dangerous occurrence (i.e. an incident that does not result in a reportable injury, but which clearly could have done).

The Law Commission recently recommended that a special offence of corporate killing be introduced (see box opposite for details). Its proposals are broadly supported by the Home Office; indeed, it is likely that the proposed new legislation will be the subject of a White Paper in the near future. However, not all agree with the proposal. For instance, the Confederation of British Industry (CBI) have labelled the new suggestions as being unfair to businesses. It sees the way forward as building on current health and safety legislation, resourcing enforcers, encouraging best practice, and through consultation on new penalties.

**Accident investigation**

Current UK (RIDDOR) regulations (see box) require employers to *report* work-related accidents. Although there are duties under some health and safety law that may lead employers to *investigate* accidents, and to take account of the lessons learned, there is no explicit duty to do so. According to the HSC many employers do undertake accident investigation in order to ensure lessons are learned, but this is not universal and investigation practices vary across industry sectors and types of business. It thus recently outlined a number of

**Corporate Killing**

The Law Commission has recommended that:

- A special offence of corporate killing should be introduced.
- The test for the corporate offence should be whether the corporation's conduct in causing death fell far below what could reasonably be expected.
- The corporate offence should not require that the risk be obvious or that the defendant be capable of appreciating the risk.
- A death should be regarded as having been caused by the conduct of the corporation if it is caused by a ‘management failure’, and the way in which its activities are managed or organised fails to ensure the health and safety of persons employed in or affected by its activities.
- Such a failure will be regarded as a cause of a person's death even if the immediate cause is the act or omission of an individual.
- Individuals within a company could still be liable for the offences of reckless killing and killing by gross carelessness as well as the company being liable for the offence of corporate killing.

Source: *The Home Office*.

proposed changes to the law to make investigation of workplace incidents compulsory. These proposals are under consultation<sup>12</sup> until September 2001 and cover issues including:

- the legislative route to be taken (e.g. whether the proposals become part of RIDDOR or the MHSWR);
- what sort of accidents should be investigated (e.g. just those currently reported under RIDDOR);
- who should be responsible for the investigation;
- arrangements for keeping a record of investigation;
- who should have access to the investigation findings (e.g. should those affected by the accident have a right to view the findings).

**Directors' responsibilities**

HSC are also developing a code of practice on directors' responsibilities for health and safety, in conjunction with stakeholders, and has published a draft code. Under the proposed code, boards of directors need to:

- accept formally and publicly their collective and individual role in providing health and safety leadership in their organisation;
- ensure all Board decisions reflect their health and safety intentions as laid down in their health and safety policy statement;
- recognise their role in engaging the active participation of their staff in health and safety;
- ensure they are kept informed of and alert to relevant health and safety risk management issues (HSC recommends each Board to appoint a health and safety director).

This has been welcomed by RoSPA (Royal Society for the Prevention of Accidents) which had been running a campaign to promote a more active role for Directors in improving health and safety in the workplace. However, the CBI is seeking clarification over the legislative status of the code of practice, and would oppose its introduction as a formal approved code of practice.

### Improving consultation

The HSC recently proposed a new package to improve employers' consultation with workers on health and safety issues. Among the proposals were new regulations to harmonise general consultation arrangements, and to empower employees to decide whether they wish to be consulted on health and safety directly or through elected representatives. The regulations specify the functions of elected representatives and are backed up by a new Approved Code of Practice. HSC will launch a formal consultation in the Summer 2001. The CBI opposed several of the legislative options suggested (including roving safety representatives) stating that any regulatory system should retain flexibility to allow employers to consult in a way which is appropriate for their workplace and workforce. It is currently considering the issues and whether changes would be appropriate to the current regulations.

### Annual reporting of health and safety

Companies are not currently required by law to include health and safety information in their annual reports. However HSC guidance makes it clear that it regards this as good practice and encourages companies to include:

- general health and safety information (e.g. goals, risks, progress towards achieving stated health and safety aims, consultation arrangements);
- the number of deaths and injuries reported under RIDDOR, including brief details of any fatalities and the steps taken to prevent any recurrence;
- details of employee days lost to the company through health and safety problems, details of any convictions or enforcement notes and an assessment of the cost to the company of the occupational injuries and illnesses suffered by the company's staff.

Organisations such as the CBI point out that many companies already report their health and safety performance in various ways. While it supports a requirement that allows companies the flexibility to report relevant data in a format most suited to the audience with which they wish to communicate, it would oppose any prescriptive legal requirement for annual reporting.

### Health and safety performance monitoring

HSE guidance recommends that systems measuring a company's health and safety performance should include both active and reactive monitoring. Active monitoring gives feedback on performance before risks result in injury, ill health, etc. (e.g. by systematic inspection, environmental monitoring and health surveillance). Reactive monitoring involves looking at incidents causing injuries or ill health as well as 'near misses'. One such system has recently been introduced to the rail industry throughout the UK. CIRAS (Confidential Incident Reporting and Analysis System)<sup>13</sup> is a system for anonymous reporting of errors, near-misses and breaches of procedure on the rail network. Data obtained under a trial period have provided evidence of 'sharp end' errors and difficulties such as perception of signals and maintaining attention, as well as latent factors, such as attitudes of management toward safety issues. The

benefit of this broad-based analysis is twofold. First, specific reports can be acted upon to improve safety (e.g. changes to braking procedures and signalling). Second, a database of human factors issues can be built up, serving as a valuable resource for the whole rail industry, allowing generalisations as to the likelihood of accidents in particular contexts. Confidential error-reporting schemes are increasingly seen as essential features of all industries where safety is an issue.

## Overview

Human error is inevitable. Reducing accidents and minimising the consequences of accidents that do occur is best achieved by learning from errors, rather than by attributing blame. Feeding information from accidents, errors and near misses into design solutions and management systems can drastically reduce the chances of future accidents. Hence, studying human error can be a very powerful tool for preventing disaster.

### Endnotes

- 1 Feyer, A.M. & Williamson, A.M. (1998): Human factors in accident modelling. In: Stellman, J.M. (Ed.), *Encyclopaedia of Occupational Health and Safety, Fourth Edition*. Geneva: International Labour Organisation.
- 2 Institute of Medicine (2000): *To err is human: Building a safer health system*. Washington: National Academy Press.
- 3 Reason, J. (1989): *Human Error*. Cambridge: CUP.
- 4 Norman, D. (1988): *the Psychology of Everyday Things*. New York: Basic Books.
- 5 Duncan, K. D. (1987). Fault diagnosis training for advanced continuous process installations. In: Rasmussen, J., Duncan, K., and Leplat, J. (Eds), *New Technology and Human Error*. Chichester: Wiley.
- 6 Rasmussen, J. (1980). The human as a systems component. In: Smith, H.T. and Green, T.R.G. (Eds), *Human Interaction with Computers*. London: Academic Press.
- 7 Health and Safety Executive (1999): *Reducing error and influencing behaviour*. London: HMSO.
- 8 Guest, D.E., Peccei, R. & Thomas, A. (1994): Safety culture and safety performance: British Rail in the aftermath of the Clapham Junction disaster. Paper presented at the Bolton business school conference on changing perceptions of risk, Bolton, February 1994.
- 9 Lee, T. & Harrison, K. (2000): Assessing safety culture in nuclear power stations. *Safety Science*, **34**: 61-97.
- 10 Leape, L. (1994): Error in medicine. *Journal of the American Medical Association* **272**: 1851-1857.
- 11 Clarke, S. (1998): Organisational factors affecting the incident reporting of train drivers. *Work & Stress* **12**: 6-16.
- 12 HSE/C (2001): Proposals for a new duty to investigate accidents, dangerous occurrences and disasters. <http://www.hse.gov.uk/condres> visited on 11/05/01.
- 13 Davies, J.B., Wright, L., Courtney, E. & Reid, H. (2000): Confidential incident reporting on the UK railways: The CIRAS system. *Cognition, Technology & Work* **2**: 117-125.

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