Chapter 4

Violations and the Varieties of Rule-related Behaviour

Chernobyl and Zeebrugge

It was the Chernobyl disaster in April 1986 that first aroused my interest in violations.[1] This was largely due to human actions: mistakes on the part of the experimental planners, one serious operator slip (undershooting the required power level), and a series of ill-judged but deliberate deviations from safe operating procedures just prior to the explosions. It was these last unsafe acts that appeared to require a distinction between errors and violations.

The operators' actions in the last half hour, though involving major transgressions of plant-operating procedure, were all consistent with their goal of achieving the conditions required for the repeated testing of an electrical device. Ironically, this voltage generator was designed as a safety measure. In the event of an off-site power failure, it was intended to bridge the two to three minute gap before the standby diesel generators could produce sufficient power to drive the pumps of the emergency core cooling system.

Procedural violations may be committed for many reasons. Usually, they are deliberate but non-malevolent deviations from safety procedures, rules and regulations. While the non-compliance is intended, the bad outcomes that occasionally ensue are not – unless, that is, the violations are committed by terrorists or saboteurs. We will consider the many different kinds of violation later, but for now let us return to the Chernobyl tragedy.

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1 Reason, J. (1967) 'The Chernobyl errors'. Bulletin of the *British Psychological Society*, 40: 201–206.

The power plant operators were caught in a system double bind. They were given a task that was not only beyond their experience and competence, but which made violations inevitable. Some of these were written into the plan – disconnecting the emergency core cooling system, for example – others were necessary to allow the electrical engineers from Moscow the opportunity of repeated testing: uncoupling the steam drum and the turbine automatic safety systems. As in many other disasters, the unfortunate operators were the inheritors of a complex series of failures in the system at large. If we are to understand the nature of violations, we have to look beyond the actions of the people on the spot and examine the weaknesses of the total system.

Evidence heard at the Zeebrugge disaster (occurring in March 1987) suggests that a comparable system double-bind existed aboard the roll-on-roll-off ferry, the *Herald of Free Enterprise*[2]. The ferry sailed from Zeebrugge with the bow doors open in contravention of shipping regulations. The ship capsized soon after leaving the harbour when water entered the open mouth of the car deck, toppling its intrinsically unstable (top-heavy) design. Why were the doors not shut? Because there were only two officers available to supervise three widely spaced operations, despite earlier industrial action to achieve adequate crewing. Why was the Master not aware that the doors were open? Because the ship operated a system of negative reporting: in the absence of any message to the contrary, he assumed the doors had been shut. Furthermore he had no direct way of knowing that they were open or shut. The management had earlier refused a request to install warning lights on the bridge on the grounds of expense. These were subsequently fitted to other ferries in the fleet for a few hundred pounds apiece.

'Impossible' Accidents

The Chernobyl operators and the crew of the *Herald* would surely not have committed their respective violations had they believed that their actions would lead to their disastrous consequences. So why did they act as if they were invulnerable?

2 Sheen, Mr Justice. (1987) *MV Herald of Free Enterprise*. Report of Court No. 8074 Fomal Investigation. London: Department of Transport.

Each group had probably committed violations with impunity in the past. Only when these particular violations combined with a large number of other factors did they lead to catastrophe; and in neither case was any one person in a position to predict the future conjunction of these singly insufficient but necessary causal strands – a situation that Willem Wagenaar[3] has aptly termed 'the impossible accident'. In addition, the possibility of a catastrophic outcome, by virtue of its rarity, would not have weighed heavily when set against the advantages gained by achieving the immediate production goals. It may even be that such consequences were unimaginable to those at the sharp end, and thus discounted altogether.

Violations Considered as Unsafe Acts

As we shall see shortly, violations come in a variety of forms and not all of them, by any means, are unsafe. However, at the outset of our research into violations – that is, studies relating to road traffic accidents and lost time injuries in oil and gas exploration – the emphasis was very much upon their dangers.

We grouped errors and violations under the general heading of unsafe acts, and classified non-compliances (like errors) according to the level of performance at which they occurred: skill-based, rule-based and knowledge-based. In each case the decision not to abide by the rules and procedures was shaped by individual, contextual, social and systemic factors, though the balance of these influences varies from one type of violation to another.

Violations at the Skill-based Level

These violations form part of a person's repertoire of skilled or habitual actions. They often involve corner-cutting (i.e., following the path of least effort between two task-related points). Such *routine violations* are promoted by inelegant procedures and

3 Wagenaar, W.A. (1986) *The Cause of Impossible Accidents*. The Sixth Duijker Lecture, University of Amsterdam. See also Wagenaar, W.A. and Groeneweg, J. (1987) 'Accidents at sea: Multiple causes and impossible consequences'. *International Journal of Man-Machine Studies*, 27: 587–598.

a relatively indifferent environment. That is, one that rarely punishes violations or rewards compliance.

Looking down on a city park, for instance, we can see the walking routes that were intended by the landscape architect. And we can also see the muddy tracks through the grass that the park's users preferred if they intended to take the shortest path between, say, a bus stop and an underground station.

In general, there is little need to proceduralise activities at the skill-based level. For the most part, actions are governed by stored habits of action whose details are, in any case, beyond verbal control, or even recall. There is no point, for example, in writing procedures to tell a skilled tradesperson how to use a screwdriver.

Where procedures do cover activities at the skill-based level, they tend to take the form of general exhortations (e.g., Proceed with due caution ... Care should taken when ... etc.).

Optimising violations – thrill-seeking violations – also feature large at the skill-based level. This category is not so much a separate type of violation as an acknowledgement that human action serves a variety of goals, and that some of these are unrelated to the purely functional aspects of the task. Thus a driver's functional goal is to get from A to B, but in the process he or she (usually he) can seek to optimise the joy of speed or indulge aggressive instincts. Similarly, mariners may deviate from safe operating procedures in order to alleviate the tedium of an otherwise uneventful voyage – for example, they can sail closer to an approaching vessel in order to demonstrate their ship-handing skills (a contributing factor in several collisions).

These tendencies to optimise personal rather than strictly functional goals can become an embedded part of an individual's performance style. We see this very clearly in car driving. They are also characteristic of particular demographic groups, most particularly young males.

Violations at the Rule-based Level

Safety procedures, rules and regulations are written primarily to control behaviour in problematic or risky situations, and are most abundant at the rule-based level of human performance.

In the initial stages of a particular system or technology, the procedures may simply provide instructions on how to do the job and how to deal with foreseeable hazards. But procedures are continuously being amended to incorporate the lessons learned from past incidents and accidents. Such modifications usually prohibit specific actions that have been implicated in some previous adverse event. The upshot is that the range of allowable actions gradually diminishes as the technology matures. However, the range of actions necessary to complete the task within operational or commercial constraints may not diminish. In short, the scope of allowable action becomes less than the scope of necessary action. Whereas errors arise from the under-specification of mental processes (see Chapter 3), violations can be provoked by regulatory and systemic over-specification of permitted actions. This creates the conditions for *necessary or situational violations.* These are situations for which violations offer possible or, in some cases (e.g., Chernobyl), the only solutions.

The character of situational violations can be illustrated with an example drawn from railway shunting. The British Rail 'Rule Book' (amended every six months) prohibited shunters from remaining between wagons during easing up; that is, when a set of wagons is propelled by a pilot engine towards some stationary wagons to which they will be attached. Only when the wagons are stopped can the shunter compliantly get down between them to make the necessary coupling. On some occasions, however, the shackle for connecting the wagons is too short to be coupled when the buffers are at their full extension. The job can only be done when they are momentarily compressed as the wagons first come into contact. Thus, the only immediate way to join these particular wagons is by remaining between them during the easing-up process.

In the last days of British Rail (prior to 1994), an unacceptable number of shunters died each year as the result of being trapped between the buffers. This illustrates a sad point: violations per se need not harm you; it is the errors that are made when violating that can prove fatal. We will return to this point later.

The shunting example illustrates an important point about situational violations: whereas routine and optimising violations are clearly linked to the attainment of personal goals – that is,

least effort and thrills – necessary violations have their origins in the deficiencies of the workplace and system. Initially, non-compliance is seen as essential in order to get the job done. But, once done, it is often seen that they are an easier way of working and become part of the person's habitual skill-based performance.

Rule-based violations are likely to be more deliberate than skill-based violations. However, just as mistakes are intentional actions carried out in the belief that they will achieve their desired ends, so situational violations are deliberate acts carried out in the belief that they will not result in bad consequences. These violations are shaped by cost-benefit trade-offs (of which more later) where the benefits are seen as outweighing the possible costs.

Such assessments can be mistaken. Thus, situational violations can involve both mistakes and procedural non-compliances. We will discuss 'misventions' (a blend of mistaken circumventions) further when we come on to consider the varieties of rule-related behaviour.

Violations at the Knowledge-based Level

Activities at the knowledge-based level take place in atypical or novel circumstances for which there is unlikely to be any specific training or procedural guidance. Trainers and procedure writers can only address known or foreseeable situations.

The Chernobyl disaster provides perhaps the best-documented account of *exceptional violations*. When the power level fell below 25 per cent, the plant was in a dangerous condition, being liable to positive void coefficient (reactivity that could and did spiral out of control). After that, almost all the activities were exceptional violations – or, more accurately, mistaken circumventions – that made the explosions inevitable. The operators persisted in successively shutting down safety systems in apparent ignorance of the basic physics of the reactor and in the hope of completing the tests in a diminishing window of opportunity.

Problems encountered at the knowledge-based level do not have to be novel in the sense that the surface of Mars would be to some future astronaut. Quite often they involve the unexpected

occurrence of a rare but trained-for situation, or an unlikely combination of individually familiar circumstances.

Consider the following situation (one that has occurred on a number of occasions with fatal consequences): two people are inspecting an oil pipeline. One of them jumps into the inspection pit and is overcome by deadly hydrogen sulphide fumes. His colleague, although trained to cope with such a situation (i.e., to radio for help and stay out of the pit), obeys a primitive impulse and jumps down to help his partner, whereupon he too is overcome. The problem, although covered by training, had never been met before by this person in its harsh reality.

This is an area in which violations can shade into heroic recoveries. We will discuss these in a later chapter.

Who is Most Likely to Violate?

Whereas error rates do not change markedly with gender or age (at least within the normal span of working life), those people most likely to bend the rules form a comparatively easily identified group. Their principal demographic and psychological characteristics are listed below:

- Young men;
- Having a high opinion of their work skills relative to others;
- Who may be relatively experienced and not especially error prone;
- Who are more likely to have a history of incidents and accidents;
- And who are significantly less constrained by what other people think and by negative beliefs about outcomes.

Why Do People Violate Safety Rules?

Given the close association between violating and young males, it is tempting to put it all down to an excess of testosterone. Young males generally have rude health, quick reflexes and are at the peak of their physical abilities, all of which cry out to be tested to the limit.

Fortunately, the psychological and physical pressures to violate diminish fairly rapidly with advancing years. In part, this increased compliance is associated with a growing awareness of one's own mortality, morbidity, vulnerability and general frailty in the face of dangerous hazards, not to mention increased responsibilities and family ties.

Equally, or perhaps even more importantly, age-related compliance is also due to the middle-aged and the elderly having different reference groups (people whose opinions they value) to the young, and these more mature 'significant others' don't, in general, condone violations. The same factor probably also plays a large part in gender differences: violating is not something that other women are especially likely to value or admire.

In any case, putting it all down to testosterone doesn't get us very far, since we have no socially acceptable way of doing anything about it. (Indeed, most societies exploit these young male attributes by recruiting them to fight their wars and police their streets.) So we have to ask more manageable questions. In particular, what are the attitudes, beliefs, group norms and situational factors that promote potentially unsafe violations? Some of these can be changed, albeit with some difficulty.

Our research on driving violations suggests that non-compliance is directly related to a number of potentially dangerous beliefs. Some of the more important of these 'illusions' are listed below:

- *Illusion of control:* habitual violators feel powerful and overestimate the extent to which they can govern the outcome of risky situation. Paradoxically, they can also have the opposite feelings (powerlessness) in certain circumstances – such as speeding – where they feel that their own behaviour is merely conforming to the local traffic norms.
- *Illusion of invulnerability:* violators underestimate the chances that their rule breaking will lead to adverse consequences. Skill, they believe, will always overcome hazards. By the same token, young men do not see themselves as the likely victims of other people's bad behaviour. In a recent study, young males were asked to judge the likelihood that they would be victims of street crimes relative to other demographic groups. They made a sevenfold underestimate of their actual chances of being mugged or assaulted on the streets. They are, in fact, the demographic group at greatest risk. Similar tendencies are likely to operate when driving or working in hazardous conditions. They feel 'fireproof'.
- *Illusion of superiority:* this has two aspects. First, people who score highly on self-reported violation questionnaires rate themselves as being more skilled (particularly in driving) than others. Second, they do not view their own tendencies to violate as being worse than those of other people.

We can also express these tendencies to violate as a series of statements:

- 'I can handle it.'
- 'I can get away with it.'
- 'I can't help it.'
- 'Everyone does it.'
- 'It's what they [the company] really want.'
- 'They'll turn a blind eye.'

The Mental 'Economics' of Violating

Violations are deliberate acts. People can weigh up the perceived costs and benefits of an act of non-compliance, and when the benefits exceed the possible costs they are likely to violate[4]. A table outlining the violation 'balance sheet' is shown in Table 4.1.

For many acts of non-compliance, experience shows that violating is often an easier way of working and brings no obvious bad effects. The benefits are immediate and the costs are seemingly remote and, in the case of accidents, unlikely.

The challenge here is not so much to increase the costs of violating (by stiffer penalties and the like) but to increase the perceived benefits of compliance. That means having procedures that are workable and describe the quickest and most efficient ways of performing the task. Any lack of trust caused by inappropriate or clumsy procedures will increase the perceived benefits of violating.

4 Battmann, W. and Klumb, P. (1993) 'Behavioural economics and compliance with safety regulations.' *Safety Science*, 16: 35–46.

Table 4.1 Summarising the violation 'balance sheet'

Perceived Benefits	Perceived Costs
Easier way of working	Causes accident
Saves time	Injury to self or others
More exciting	Damage to assets
Gets the job done	Costly to repair
Shows skill	Sanctions/punishment
Meets a deadline	Loss of job/promotion
Looks macho	Disapproval of friends

Bad Procedures

It would be a mistake to think that most violations are due to bloody-mindedness on the part of the workforce. Attitudes and beliefs leading to non-compliance are only half the problem. The other half, or more, arises from bad procedures.

In the nuclear industry, for example, nearly 70 per cent of all human performance problems could be traced to bad procedures. That is, procedures that gave the wrong information, or were inappropriate and unworkable in the current situation, or were not known about, or were out of date, or that could not be found, or could not be understood, or that simply had not been written to cover this particular task. Bad, absent or unworkable documentation is not a monopoly of the nuclear power industry.

Procedure-usage

In a survey of procedure usage within a large petrochemical plant in the north-west of England,[5] it was found that whereas safety-critical and quality-critical jobs are associated with a high proportion of procedure usage (80 per cent), less than half of the respondents stated that they used procedures while solving problems (30 per cent) – even safety-critical ones – or while carrying out maintenance work (10 per cent). However, only 58 per cent of the 4000 people surveyed reported that they had the procedures open and front of them while they are actually

5 Embrey, D.E. (1999) Personal communication.

carrying out jobs. People do not usually do and read at the same time.

In many highly proceduralised industries, it is common for the workforce to write their own accounts of how jobs should be done. These are jealously guarded and passed on to new members of the workgroup. They are often known as 'black books'. The procedure-usage survey, discussed above, found that 56 per cent of operators and 51 per cent of managers used these informal procedures.

Below are listed some of the reasons given by petrochemical workers for not following the formal procedures:

- If followed to the letter, the job wouldn't get done.
- People are not aware that the procedure exists.
- People prefer to rely on their own skills and experience.
- People assume that they know what is in the procedure.

Testing Two Models of Violating Behaviour

Behavioural Cause Model

This model was tested on 182 operators working on an offshore platform in the North Se.[6] It was found that the model allowed successful prediction of 64 per cent of the variance in violating behaviour with just four major factors providing the dominant drive to violate. These are listed below:

1. *Expectation*: the person's estimation of the likelihood that they will perform some specified behaviour (such as violating).
2. *Opportunity*: the possibilities an individual has to work in another (better more efficient) way and their judgement of the consequences of working in that way.
3. *Powerfulness*: the person's feeling of superiority, competence and skill based on their experience.
4. *Planning*: the quality and efficiency of the planning process that precedes the work.

6 Verschuur, W., Hudson, P., and Parker, D. (1996) *Violations of Rules and Procedures: Results of Item Analysis and Tests of the Behavioural Cause Model*. Field Study NAM and Shell Expro Aberdeen. Report Leiden University of SIEP.

Knowing an individual's scores on these four factors allows the prediction of whether they are likely to violate or not. These predictions account for two-thirds of the variance in actual violating behaviour. Predicting or explaining the variance is not only a measure of accuracy, it also indicates how much other factors not considered could also be influential. The fact that these four factors explained 64 per cent of the variance means that any other factors would only have a minority effect.

To put these proportions into perspective, most behavioural predictions are about 20–30 per cent accurate and even large opinion polls can only reach such accuracy with samples larger than 1000 and very simple voting behaviour.

Supervision and Punishment Model

An alternative model is to assume that people are bad and lazy. Violating is the norm unless they are forced to comply by (a) detection of violations by supervisors and (b) strong punishment meted out to the violator on detection. When tested, as above, this model was found to account for only 20 per cent of the variance.

When the two models are combined (by adding both sets of factors into the equation), the total variance explained only rose from 64 per cent to 67 per cent, a negligible increase.

The message is clear. Effective management of potentially dangerous violating behaviour depends upon an understanding of the significant driving factors rather than relying upon untested preconceptions. Focusing upon detection, supervision and punishment will only produce marginal improvements; while concentrating upon the four factors of the Behavioural Cause Model could produce major reduction in violating behaviour.

The Varieties of Rule-related Behaviour

So far, we have looked at violations from the point of view of managers of hazardous industries for whom violations are regarded as a major threat to safety. This is indeed true, but there is a wider perspective that starts from the premise that neither compliance nor violating is intrinsically good or bad – it all depends on the local context. To understand the wider varieties of

rule-related behaviour, we need to consider a number of systemic and personal factors.

Rule Quality

Since all the ways in which harm can come to people or assets can never be wholly knowable or considered likely, there will always be situations for which no safety procedures are available. And, as we have seen earlier, the procedures can be wrong or inappropriate for the circumstances. Thus, for any one situation, there can be good rules, bad rules or no rules.

Correct and Incorrect Actions

Here, the extent to which an action may be deemed correct or incorrect depends upon the accuracy of the actor's hazard perception. Recognising that a situation is dangerous or that a particular procedure is inappropriate is likely to lead to correct behaviour – that is actions shaped by an appropriate awareness of the need to minimise the risk. Behaviour that disregards the dangers, even though it may satisfy the individual's personal goals, is likely to be incorrect.

Psychologically Rewarding and Unrewarding Actions

Psychologically rewarding actions are those that satisfy the personal goals of the actor. These can be in line with the organisation's objectives or not; they can be compliant or non-compliant, correct or incorrect. For some people, violating serves a personal need for excitement or least effort; for others, it can be a source of guilt and worry even when the rule is inappropriate for the situation. Table 4.2 shows a summary of the 12 varieties of rule-related behaviour and these are discussed in more detail as follows:

1. *Correct and rewarding compliance* In any moderately successful organisation, this is likely to be the largest single category of rule-related behaviour. Procedures are tweaked and adjusted over the years so that they become a more efficient and safer way of working. If this is how they are perceived

Table 4.2 Summarising the 12 varieties of rule-related behaviour

Where the task was covered by an appropriate rule or procedure (good rules)

- Was the procedure followed and was it psychologically rewarding?
  - If YES → Correct and rewarding compliance (1)
  - If NO → Correct but unrewarding compliance (2)
- If the procedure was not followed was it psychologically rewarding?
  - If YES → Incorrect but rewarding violation (3)
  - If NO → Mistaken circumvention (misvention) (4)
- Was the non-compliance motivated by a desire to damage the system?
  - If YES → Malicious circumvention (malvention or sabotage) (5)

Where the task was covered by some inappropriate rule or procedure (bad rules)

- Was the procedure followed and was it psychologically rewarding?
  - If YES → Incorrect but rewarding compliance (6)
  - If NO → Mistaken compliance (mispliance) (7)
- If the procedure was not followed was it psychologically rewarding?
  - If YES → Correct violation (8)
  - If NO → Correct but unrewarding violation (9)
- Was the compliance motivated by a desire to disrupt the system?
  - If YES → Malicious compliance (malpliance or working-to-rule) (10)

Where the task was not covered by a rule or procedure (no rules)

- Did the knowledge-based improvisation yield a good or acceptable outcome?
  - If YES → Correct improvisation (11)
  - If NO → Mistaken improvisation (12)

by the workforce, then compliance will, in general, be more psychologically rewarding than non-compliance.

2. *Correct but unrewarding compliance* Even in the best organisations, however, there will be situations in which the rules are viewed as necessary but nonetheless irksome. Wearing hard hats, high-visibility garments and safety boots on a hot day can be very trying, even though they are seen as necessary for preserving life and limb. Road works that require traffic to alternate in both directions along a single lane signalled by temporary red and green lights can be very frustrating, particularly when we see a clear way through ahead. Usually, though, we curb our impatience and obey the lights because we accept the need for their flow control and welcome an improved road surface.

3. *Incorrect but rewarding violation* These are dangerous because they are habit-forming. Every incorrect but personally rewarding unsafe act increases the likelihood that it will be repeated over and over again, becoming a part of the individual's routine skill-based activities.

   As mentioned earlier, it is not the violation per se that is necessarily dangerous, but the fact that it can increase the probability of a subsequent error in an unforgiving environment. Driving at 100 mph need not in itself be hazardous, rather it is that the driver can become over-confident about judging speed and distance when the costs of a mistake could be fatal.
4. *Mistaken circumvention (misvention)* These are violations that are neither correct nor rewarding and which carry a high penalty. In these instances, the decision to deviate from appropriate safety rules is almost certainly mistaken. The most tragic example of misventions was the behaviour of the Chernobyl operators discussed earlier.
5. *Malicious circumvention (malvention)* Malventions are rule-breaking actions in which the perpetrators intend that their violations should have damaging consequences. They range from vandalism, often committed by boys in their mid-teens, to gross acts of terrorism like those which occurred in New York and Washington on 9 September 2001 and in London on 7 July 2005, as well as in many other cities of the world. In between, there are crimes such as arson, vehicle ramming and many other forms of malicious harm. For the most part, these bad acts lie outside the scope of this book; but their occurrence in the world of hazardous work cannot be altogether discounted. Vandalism on the railways, for example, remains a significant threat in many parts of Britain.
6. *Incorrect but rewarding compliance* Adherence to inappropriate rules, even when they are recognised as such, can be characteristic of people for whom any kind of non-compliance is a source of considerable personal discomfort. It is not in their nature to bend the rules, good or bad; such deviations are 'more than their job's worth'. The judges at Nuremberg in 1946 had much to say on this kind of behaviour.

7. *Mistaken compliance (mispliance)* A particularly tragic instance of mispliance occurred on the oil and gas platform *Piper Alpha*, on 6 July 1988 following an explosion in the gas line. The emergency procedures required that the platform personnel should muster in the galley area of the accommodation towards the top of the platform. Sadly, this location was directly in the line of the fireball that erupted over an hour after the first explosion. Most of those who complied with these procedures died.
8. *Correct violation* Among those who survived the *Piper Alpha* disaster were the divers who deviated from the mustering instructions and descended to the bottom of the platform where they were able to use rope and a ladder to reach a rescue boat.

   Military history is rich in correct violations – though it is usually only the outcome of a battle that determines the correctness or otherwise of the deviations. Nelson won the Battle of Copenhagen because, among other things, he disregarded an order to disengage (by putting his telescope to his blind eye). The Confederate commander, General Lee, violated a basic rule of war at Chancellorsville – don't split your army in the face a superior force – when he sent General Jackson on a 16-mile flanking march that brought his force up to the far end of the Federal line and took them by surprise.

   Such fortunate violations are often taken as the mark of a great commander. For General Lee, however, such deviations could also be seen as a necessity as well as a mark of greatness since the Federal armies that he met were usually larger and always better equipped than his own. But they were, at least in the early years of the war, poorly led and easily thrown by these unconventional manoeuvres. However, even great generals have their bad days, as Lee did at the Battle of Gettysburg later in 1863. By failing to occupy Cemetery Ridge when it was largely empty of Federal troops, he created the necessity for Pickett's disastrous charge and lost the opportunity to win the war. Washington was only a few miles further on.

9. *Correct but unrewarding violation* Here an individual recognises that the local procedures are inappropriate for the task and, unlike the 'Jobsworth' discussed earlier, he or she elects not to comply with them. Although this is the correct course of action, it does not necessarily dispel his or her sense of unease at not obeying the rules. In this sense, therefore, the violations although correct are personally unrewarding.
10. *Malicious compliance (malpliance)* Rigid adherence to rules and procedures – or working to rule – was used quite often in Britain's dispute-ridden railway industry as a weapon in the labour armoury. It was the opposite of illegal, as strikes might have been, but it was nonetheless very effective. Its aim was disruption not damage, which puts malpliance into an altogether different league from malvention. When train crews worked to rule they did not endanger themselves or their passengers. Instead, amongst other things, they insisted on taking all the breaks and rest periods that were due to them, though not regularly claimed. The upshot was that trains were delayed and became scattered all over the country at the end of each day, causing major disturbance to the railway timetable.

    In other industries, working to rule has been used as a tactic of protest, seeking to show management how unworkable, excessively bureaucratic and stifling their rules and regulations were. Some degree of ill-will is present, but it's not of the kind that motivates terrorists, vandals and criminals.
11. Correct improvisation This is knowledge-based processing in the absence of rules or procedures that comes up with a happy outcome. Such improvisations are the stuff that some – but not all – heroic recoveries are made. These are the subject of Chapter 11.
12. Mistaken improvisation Failure to achieve a good outcome in the absence of procedural guidance can be unlucky as well as mistaken. Since knowledge-based problem-solving advances by trial-and-error learning, mistakes are inevitable. The deciding factor is the degree to which the situation is forgiving or unforgiving.

Great Improvisers

What makes a good 'trouble-shooter'? This is a very difficult question that I have wrestled with for many years, and to which a large part of the remainder of this book is devoted. Some people come up trumps on one occasion but not on another. Two teams may be similar in most obvious respects, but one succeeds where the other does not. Even the best people have bad days. It is my impression that the very best trouble-shooters get it right about half the time. The rest of us do much worse.

Although there is no simple answer to the question of what makes an effective improviser, I feel convinced that one of the most important factors is mental preparedness.

Some operators of hazardous technologies have a cast of mind – either as the result of training or arising from an inbuilt tendency to expect the worst, but usually both – that causes them to act out in imagination possible accident scenarios. Some of these come from their knowledge of past events; others involve linking together a combination of possible but as yet unconnected failures. In order to run these scenarios, they stock their minds with the details of past events. They also review incidents and 'free lessons'. Their interest is in the ways these inconsequential close calls could interact to defeat the systems defences. They appreciate that single faults or breakdowns, either human or technical, are generally insufficient to bring down a complex, well-defended system.

Simulators have proved to be invaluable tools in promoting 'requisite imagination'. A number of near-disasters, most notably *Apollo 13*, have been recovered because somebody wondered 'what would happen if' a number of unlikely events combined and then ran these starting conditions on the simulator.

End Piece

The managers of complex and hazardous technologies face a very tough question: how do they control human behaviour so as to minimise the likelihood of unsafe violations without stifling the intelligent wariness necessary to recognise inappropriate procedures and avoid mispliances? The answer must surely lie in how they choose to deploy the variety of systemic controls that are available for shaping the behaviour of its human elements.

These issues have been discussed at length elsewhere.[7] But a brief summary of these controls would be useful here.

Administrative controls have been divided into two groups: process and output controls. But a closer examination shows that they actually locate the ends of a continuum, with one extreme – process control – relying wholly upon direct guidance from centralised management (via rules and procedures), and the other – output control – entailing its relative absence, at least at the level of the frontline operators. Output control, the adjustment of local outputs to match organisational goals, depends primarily on two other modes of systemic control: social or group controls and self or individual controls. It is within these areas that the main remedial possibilities lie.

The immense variety of potentially hazardous situations requires that the governance of safe behaviour is delivered at the level of the individual work group. The key to the success of the German military doctrine of *Auftragssystem* (mission system) lay in the ability of low-level commanders to fulfil organisational goals, with or without specific orders. Translated from military to industrial safety terms, this means selecting and training first-line supervisors to provide on-the-spot action control when safety procedures are either unavailable or inapplicable.

Such a localised system of behavioural guidance makes heavy demands on the personal qualities and skills of the supervisors. An essential qualification for them is a wide 'hands-on' experience the workplace tasks and the conditions under which they are frequently performed. Such supervisors need to be 'sitewise' both to the local productive demands and to the nature of the likely and unlikely hazards. Equally important is a personal authority derived both from the respect of the workforce and the support of management. The latter, in turn, requires that safety ranks high in the list of corporate goals. Top-level commitment to safe working is an essential prerequisite of effective behavioural control.

7 Reason, J., Parker, D. and Lawton, B. (1998) 'Organizational controls and safety: The varieties of rule-related behaviour.' *Journal of Occupational and Organizational Psychology*, 71: 289–304.

But not all hazardous activities are carried out in supervised groups. When frontline operators are relatively isolated, the burden of guidance shifts from social to self controls. These demand training in both technical and mental skills. Crucial among the latter are techniques designed to enhance hazard awareness and risk perception. These are measures that promote 'correct' rather than merely successful performance. Whereas an understanding of the limitations of prescriptive process controls is necessary at the organisational level, improved risk appraisal and enhanced 'error wisdom' hold the keys to safer – that is, 'more correct' – performance at the level of the 'sharp end' individual.

Safe and productive work is not necessarily achieved by striving to reduce non-compliant actions willy-nilly. Rather, it comes from developing a portfolio of controls that is best suited to that particular sphere of operations. There is no single across-the-board best package. Controls must be tailored to both the type of activity and the needs of work teams and individuals. It seems likely, however, that those organisations with the widest spread of controls will achieve the best safety results – provided that this variety of measures is informed and supported by an effective culture. Safety culture, the obstacles facing it and the means to socially engineer it, will be the topic of my last chapter in this book.

Chapter 5

Perceptions of Unsafe Acts

In the last two chapters, I lumped together errors and violations under the general heading of 'unsafe acts'. This is not a very good label since it is only the consequences that determine whether an act is unsafe or not. An act need be neither an error nor a violation, yet it can still turn out to be unsafe, and conversely. Accepting this obvious limitation, however, I will stay with the term for the sake of precedent and simplicity. On occasions, unsafe acts are also referred to as active failures in order to distinguish them from latent conditions.

Previously, I focused upon the varieties of error and rule-related behaviour, and upon the psychological, organisational and contextual factors that promote and shape their occurrence. In this chapter, I am less concerned with the acts themselves and those who commit them than with the way they are *perceived* by significant other people. These 'significant others' include the managers of hazardous systems, directors, shareholders, stakeholders, regulators, media commentators, legislative bodies and those whose lives could be or were adversely affected by any bad outcomes (e.g., patients, passengers, customers, consumers, and end-users of all kinds).

A number of different perspectives exist, and not all are mutually exclusive. Each view constitutes a model of why unsafe acts occur and how they impact upon the operations in question. Each model generates its own set of countermeasures and preventative policies. Some of these views are rooted in folk psychology; others have their basis in engineering, epidemiology, and the law and systems theory. Four such perspectives are considered below: the plague model (or defect model), the person model, the legal model and the system model. Discussion of the person model will include an account of the vulnerable system