Second Edition

Tolley's Workplace Accident Handbook

Mark Tyler

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Editor

Mark Tyler

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Foreword

Health and safety is an issue of vital importance to all employers. Not only is it the employer's responsibility under the law to protect staff, contractors and visitors, but effective health and safety management systems save time and money and increase the efficiency of the organisation.

It remains essential to understand the factors in the workplace that can contribute to accidents, and to be well-prepared with first aid and emergency planning. We also see much scope for putting greater focus on the rehabilitation of the victims of accidents.

The CBI supports the investigation of accidents, incidents and near-misses as an integral part of effective health and safety management. It enables operators to identify what went wrong, ascertain potential gaps in their risk assessment, review current performance and put in place improved systems to prevent other incidents. New corporate manslaughter legislation and plans to increase the range of penalties for health and safety offences generally could herald a significant change in attitudes to accident investigation. Organisations will have to anticipate a more assertive response from the enforcing authorities. In the tragic event of fatalities, the involvement of the police with their powers of arrest and focus on senior management will require that companies understand the enforcing authorities' procedures and powers and their managers' and their own corporate rights and obligations.

This book deals with these and many other issues relating to workplace accidents in a practical way, and it is a welcome guide for who all work in this important area.

Janet Asherson
Head of Health and Safety, CBI

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1 Introduction

In this chapter:

Rationales for management focus on accidents

1.1 The pain, suffering and sometimes grief that work-related injuries and ill health can lead to, the disruption to family life, the financial and other pressures that can ensue, underline the moral case for organisations and individuals who work in them to prevent accidents throughout their daily activities. Conditions minimising the potential for accidents need to be maintained, and – in planning for the worst – steps must be taken to mitigate the consequences when accidents do occur by providing aid and support.

The moral case for accident prevention is obvious, but the case for management action to minimise their occurrence and effects is not difficult to make either. There is the simple utilitarian case that organisations perform better, protect their reputations and reduce their costs through the application of sound risk management principles, factors which now increasingly influence the related areas of corporate governance and corporate social responsibility. Increasingly organisations' own health as businesses or public bodies is being judged by standards that include the care taken of their employees' and the public's safety and welfare.

There is the wider economic case too, which applies to the economy as a whole. A Health and Safety Executive report (HSE, 2004) assessed the costs to British economy in 2001/2002 as being between £20 and £31.8 billion. That was between 1.9 and 3 per cent of the gross domestic product (GDP) for 2002, or around half of annual growth in GDP in the last decade. The International Labour Organization (ILO) has estimated the global costs of workplace accidents to be at least $1,250 billion.

Legal compliance is one of the strongest drivers for accident prevention. Statutes and regulations – increasingly emanating from the EU – together with the common law comprise a set of norms which are non-delegable and non-negotiable. These norms exist both as *minimum standards* which society expects all organisations to adhere to, and as a framework for *penalising* non-compliance or *compensating* victims. Legal requirements may sometimes lag behind public expectations of safety standards and good industry practice, but in many instances they can also set standards which are more demanding than managers might consider to be "reasonable" or justifiable based on their experience and their perceptions of low risks. Risk management concepts such as tolerability of risk and *ALARP* (ensuring risks are as low as is reasonable practicable) are flexible, and have their roots in the *Health and Safety at Work Act 1974* (*HSWA*) scheme of duties which are summarised in Chapter 3. Health and safety legislation is closely intertwined with best practice in risk assessment, emergency planning, fire protection, first aid and employers' liability insurance. The legal consequences which can follow for non-compliance – criminal proceedings and claims for damages – are described in their various stages leading ultimately to the courtroom are explained in Chapter 8.

In addition to these important areas this book provides guidance on aspects of accidents which are much less regulated, but which may have come to the fore as management tools, in particular the thorough investigation of accidents to learn lessons, and optional rehabilitation approach to enable employees to return to work.

Trends and targets

1.2 The last two decades have seen steadily falling numbers of fatal accidents in the workplace, and a similar but less pronounced decline in major accidents and over-3-day injuries (as classified by the *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995*). Tables 1.1–1.3 use statistics published by the HSE to demonstrate the numbers of accidents to employees reported from 1981 to 2006, and also to show these numbers adjusted to take into account the fluctuating size of the workforce by reference to the incidence rate per 100,000 employees.

The data on non-fatal accidents can be hard to interpret because the relevant reporting regulations and accident criteria have changed twice during the period, which explains the "jumps" in accident rates after 1985 and 1995. After each change, the downward trend has continued, but the rate of improvement is now slowing markedly.

Some of the improvement in accident statistics is due to changing patterns of employment, most notably the decline in mining and heavy engineering. There is some evidence that the incidence rates for non-fatal accidents to *self-employed* workers

Table 1.1: Fatal accidents to employees and incidence rates per 100,000

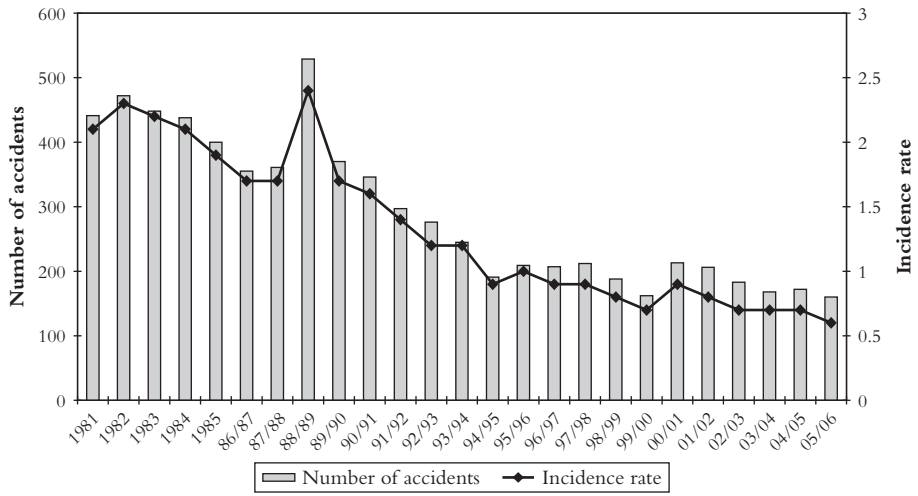
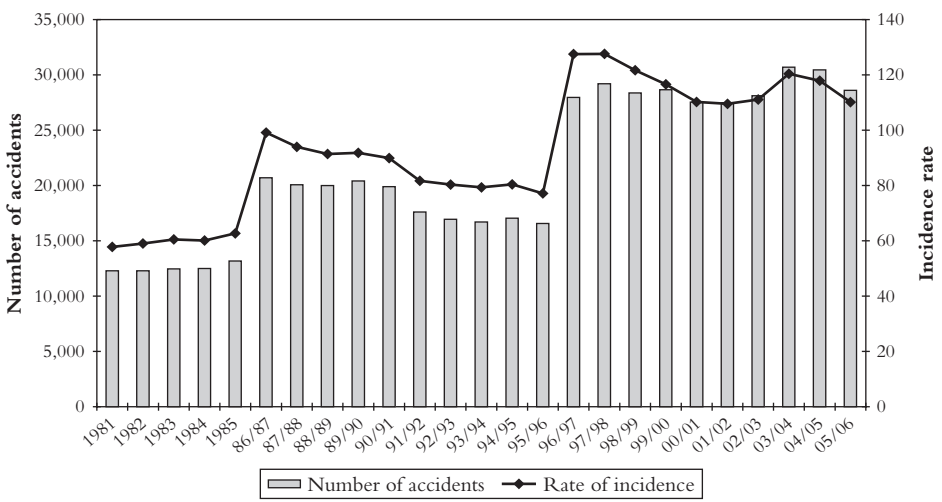


Table 1.2: Non-fatal major accidents to employees and incidence rates per 100,000



have begun to increase after 2000, possibly reflecting the shifts in the workforce away from permanent jobs and towards more fluid employment relationships.

These accident rates nevertheless compare very favourably with the situation in other developed countries. The fatal accident rate is about half the EU average

Table 1.3: Over-3-day injuries to employees and incidence rates per 100,000

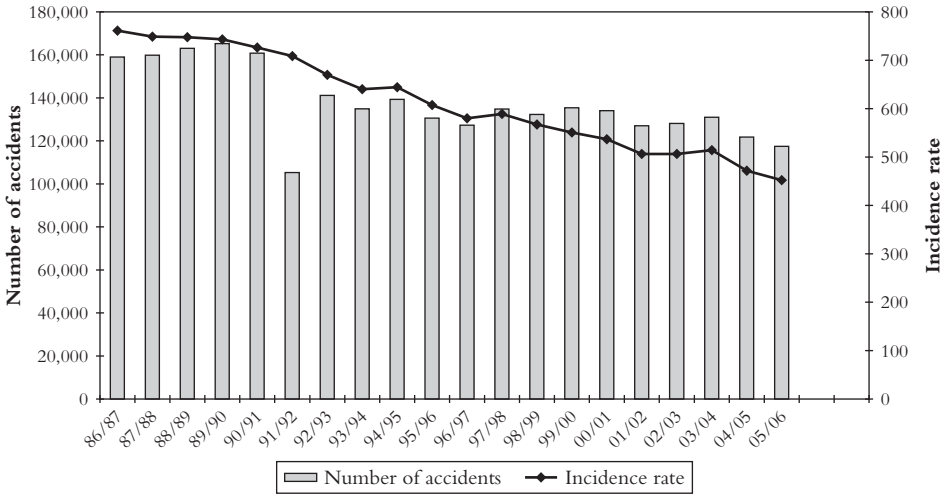
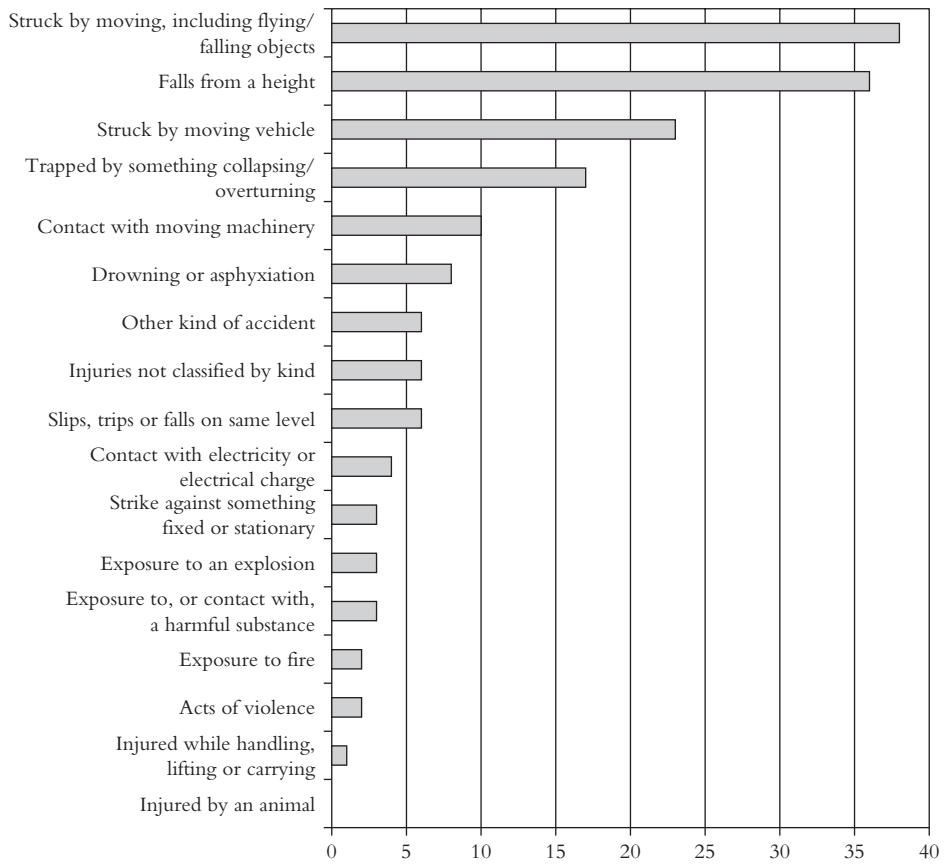


Table 1.4: Fatal injuries to employees by accident type, 2004/2005



(better than any other Member State) and around three-quarters that of the USA. Measured in terms of over-3-day accidents in the EU only Holland, Ireland and Sweden have (slightly) lower incidence rates than the UK when comparisons were made on the basis of 2003 data.

Tables 1.4–1.6, also based on HSE-published statistics, show the most frequent types of accidents causing death, major injuries or over-3-day injuries in 2004/2005. (This data was provisional at the time of writing.)

In June 2000 the HSC and the Department for Environment Transport and the Regions (as it then was) launched their *Revitalising Health and Safety* strategy (DETR, 2000). This acknowledged that though there had been steady progress since the passing of the *HSWA* the reduction in levels of accidents was slowing.

Table 1.5: Non-fatal major injuries to employees by accident type, 2004/2005

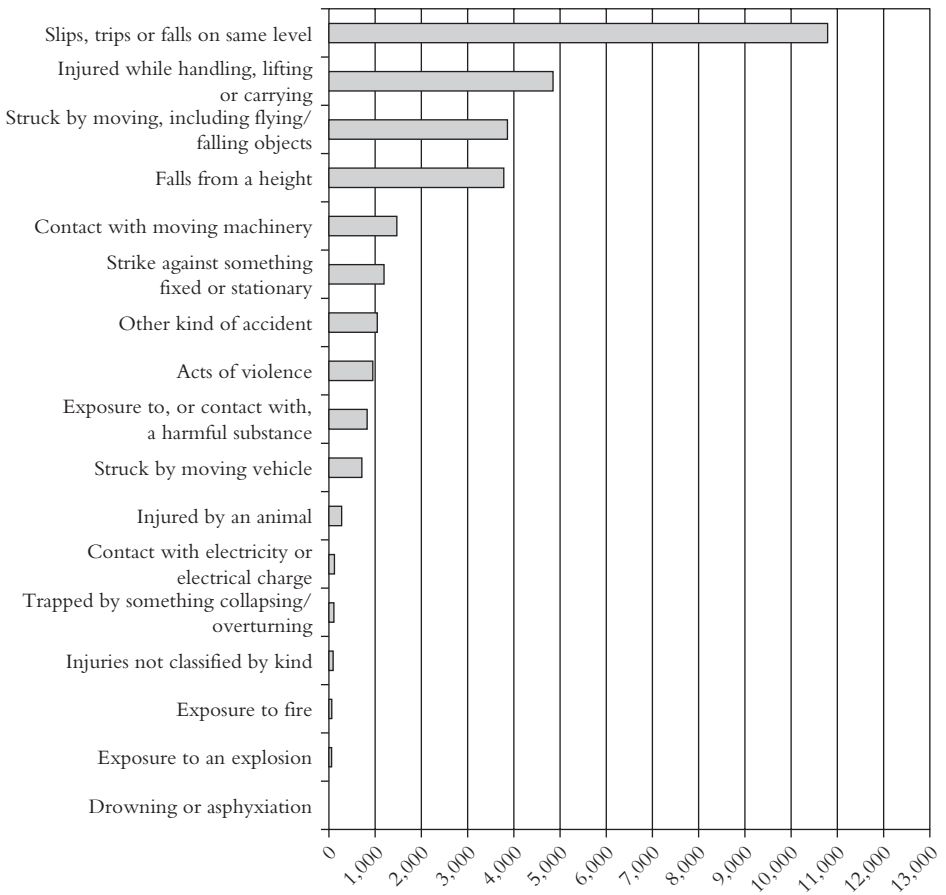
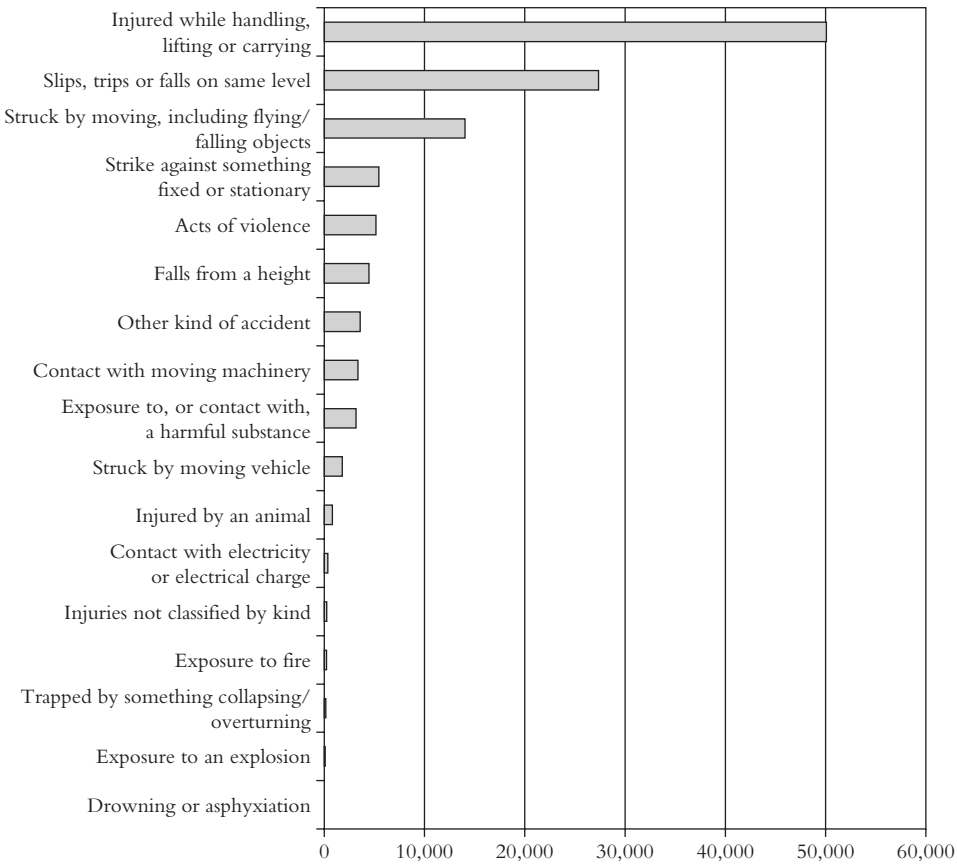


Table 1.6: Over-3-day accidents to employees by accident type, 2004/2005



The reasons for this are complex; in part it is because the "easy gains" have already been taken with the shift in economy away from manufacturing to services and the regulatory environment having reached a mature state.

The *Revitalising* strategy in 2000 set national targets for three key improvements:

1. 30 per cent reduction by 2010 in the number of working days lost per 100,000 workers from work-related ill health.
2. 10 per cent reduction in the incidence rate of fatal and major injury accidents.
3. 20 per cent reduction by 2010 in the incidence rate of work-related ill health.

Achievement of half these improvements was aimed at by 2004.

In 2004/2005 – the mid-point of the strategy – progress was disappointing. Taking into account year on year fluctuations there was a downward trend in working days lost, but no clear change for all three targets since 1999/2000 (HSE, 2005). Nevertheless, as will be seen in Chapter 10 the strategy has been successful in part in making performance targeting more a prominent feature of health and safety policy and driving safety up the agenda for senior executives. The largest companies are now routinely reporting publicly on their own individual targets for safety improvements and accident records.

Risk management

1.3 It is now widely accepted that management controls need to be supported by a defined policy set by management at the highest level, and directors of companies (and equivalent officers of other organisations) as corporate manslaughter and new duties have increasingly been in the spotlight are well advised to take a close interest in the implementation of the policy. The published guidance from the HSE emphasises their roles of providing leadership and being accountable (HSE, 2002).

The recommended structures for managing the controls are those of the HSE's guidance document *Successful Health and Safety Management* (HSE, 1997) or the closely related model given as an alternative in BS 8800 (BSI, 2004) and OHSAS 18001 (BSI, 1999) (both produced by the British Standards Institution). The aspects of the safety management system which need to be developed specifically for accident management purposes are:

- emergency planning;
- first aid provision;
- accident investigation;
- appropriate record keeping;
- active and reactive monitoring;
- provision of rehabilitation programmes;
- reviewing and auditing performance.

Most of these requirements (an important exception being rehabilitation) are subject to legal requirements. It is important that employers are aware of the relevant HSC Approved Codes of Practice (ACoPs), HSE publications and other authoritative sources of guidance on this legislation. These can be influential because they provide evidence of how the goals can be met, and they may affect what it is "reasonably

practicable" for an employer to do in cases where this is the way in which a relevant statutory duty as framed. As these are priced publications there is little alternative to filling the bookshelves with this important material unless one signs up to on-line subscription services such as *HSE Direct* which in a few years have become very comprehensive in the information they can provide.

The management tools which can support these controls include legal compliance reviews, auditing performance and benchmarking, and different forms of monitoring aimed at discerning trends and underlying causes which can be used to inform the process of planning, revising risk assessments and reviewing the adequacy of the control measures.

Risk management is attracting greater interest generally as a result of changes in attitudes for corporate governance and director's duties. The guidance for directors on the *Combined Code on Corporate Governance* for companies listed on the stock exchange (usually referred to as *Turnbull*) issued in 2003 but now updated (FRC, 2005) stated that boards of directors should understand properly the nature and extent of risks facing companies, and review systems of control at least annually including financial, operational and compliance controls, and should make an annual statement on internal control. Health and safety risks are expressly included in the guidance as being relevant for those purposes. As we will see in Chapter 10 company law and best practice are increasingly embracing these principles.

The cost of accidents

1.4 Another of the objectives of the HSC and the HSE has been to raise awareness among managers of the costs of accidents, not just the immediate costs of damages, replacement of equipment and criminal fines but the term economic cost to an organisation. For example, even a quite minor accident involving for example a person slipping on a loose stair carpet can involve substantial management time being incurred. This could involve:

- first aid provision;
- arranging transport to a doctor or hospital for treatment;
- engaging a temporary replacement worker;
- interviewing the injured person and colleagues to establish the facts;
- checking security video's records and making sure any film is not deleted;
- completing accident book and statutory accident reporting tasks;
- preparing an accident investigation report;

- payroll action to deal properly with sick pay;
- notifying insurers and/or regulatory agencies, completing their questionnaires and dealing with related correspondence;
- reviewing maintenance procedures and devising new instructions; dealing with telephone inquiry from local health and safety regulatory authority to ascertain the current situation;
- briefing the legal department/solicitor;
- meeting regulatory authority inspectors, accompanying them on an inspection of the office and providing details of the steps taken to avoid similar accidents.

At the other end of the scale, the costs of dealing with a major disaster can be enormous. For example, after the Southall rail crash of September 1997 where an express train passed a signal at danger and collided with freight vehicles in its path, the train company involved, Great Western Trains, was subject to investigation for over two years by the police and HM Railways Inspectorate. A major public inquiry was held into the causes of the accident and the train protection systems which should be available for avoiding collisions. Numerous parties from across the rail industry took part who, along with victims and the bereaved, had to be legally represented. Approximately 100 employees and managers of Great Western and Railtrack were required to give evidence to the public inquiry. Later, in criminal proceedings, Great Western and the train driver were acquitted of manslaughter but the company was nevertheless fined £1.5 million for contraventions of the *Health and Safety at Work etc Act 1974*. In addition there were massive claims for loss of life, serious injury, lost rolling stock, damage to track and infrastructure and disruption of the network. The total cost of the tragedy to all involved has never been calculated.

Accidents are reported by the HSE to cost British employees somewhere between £3.7 and £6.4 billion per year in lost wages in 2001/2002, and losses to employers of £3.9 to £7.8 billion (HSE, 2004). An example given by the HSE is an injury caused by working with an unguarded drill which cost a small engineering company £45,000, not counting the fine and costs of being prosecuted subsequently. As a rationale for accident prevention being on the management agenda, the cost of accidents has obvious attractions for promotion by the health and safety authorities: it is a rare example of them being able to point to positive economic gains which can be attained in a short-time frame.

As will be seen in later chapters there are certain tensions between on the one hand the demands of health and safety management and on the other, commercial drivers and incentives and liability considerations. The economic case is seen to ultimately

appeal to shareholders and other funders and stakeholders who exert influence on directors and senior managers. One of the latest contributions in this direction has been the HSE's on its "Ready Reckoner" homesite www.hse.gov.uk/costs/index.asp for illustrating accident and incident costs. There is no substitute however for studying one's own costs of injuries, ill health and other accident outcomes to gauge the full impact on the bottom line.

Learning from bad experiences

1.5 Accident investigations in particular are a subject of increasing importance. In 2001 the HSE undertook a consultation on proposals for a new statutory duty to investigate accidents, as there is no explicit statutory duty to do this and it was seen by some as an important gap in the existing legislation (HSE, 2001a). Although previous consultation had seemed to indicate widespread support for a duty to carry out investigations which are proportionate to the scale or complexity of an incident, the HSE eventually announced in 2003 that new regulations would not be taken forward. Instead, new HSE guidelines were drawn up. The Chairman of the HSC was quoted as saying:

> "We want people to learn the lessons from work-related incidents with the potential to cause injury and ill health so that they can prevent similar occurrences in the future. We recognise that some employers need help to tackle this issue, so we are preparing a range of guidance material. We will monitor the effectiveness of this guidance closely – and if there is no improvement in incident investigation then we may consider the possibility of recommending new legislation."

From a risk management perspective good accident investigation techniques are highly desirable. Careful gathering of information from a variety of sources about accidents and "near-misses" builds an understanding of the underlying as well as immediate causes of accidents, helps prevent recurrences and can reduce future legal liabilities and damage to employment relations. It is also important for monitoring trends, reviewing the effectiveness of safety policy and prioritising the commitment of resources and effort in accident prevention. The process of investigation does not always though sit easily with concerns for liability or disciplinary procedures which may face individuals or the organisation collectively after an accident, particularly a serious one. Investigation ideally needs to be carried out with total objectivity, active participation and without seeking to identify or apportion blame. The threat of criminal penalties or dismissal for misconduct is far from being conducive to these goods and it is another example of non-aligned, or even competing, policy objectives in accident prevention.

Insurance and benefits

1.6 Insurance arrangements and social security are used to spread the financial risks involved in accidents. It might be thought that the insurance market promotes accident prevention policies, since better risk management should make it easier for organisations to obtain cover at the most competitive premium rates, and conversely organisations with poorer records and safety management systems would be penalised. In practice the market has not always been able to operate this efficiently.

Employers' liability insurance has been compulsory in the UK for over thirty years, it has historically been loss-making for insurers. 2003 saw a crisis in this area of the insurance market and others (such as public liability) as capacity shrank and premiums rose dramatically after five years of underwriting losses totalling £761 million. There were various reasons for this: among them the weak balance sheets of insurers after the decline in stock markets after 2001 and the long-tail liabilities for asbestos. Even employers with good claims records struggled to obtain cover. In response to a government consultation exercise in 2003 on the case for reforming employers liability insurance the Association of British Insurers argued that no one benefited from the present system and that "claimants, employers, insurers and the public interest are all being short-changed". The fundamental problem however is that the availability of universal insurance and benefits provides little financial incentive to the creator or "owner" of the risk to guard against large financial losses. Unless there are means of rewarding those who manage risk effectively (something akin to the motor insurance no-claim bonus) and means of re-distributing the financial risks more effectively to those who are responsible for the risks to health and safety (insurers' health and safety audits and individually assessed premiums) insurance may have little impact as a driver.

The Government began to address these issues in the 1990s when social security benefits paid to accident victims were clawed back from defendants to personal injury claims. Even so, continuing benefits would be payable in cases of long-term incapacity of accident victims, and in the present context, the re-distribution of cost is still largely borne by insurance.

The "*Revitalising*" strategy in 2000 identified the need to re-design benefits and insurance systems to give positive motivation for improved health and safety performance. In practice this is likely to mean closer examination in future of ways in which reduced premiums or other credit can be given to organisations on the basis of their individual risk profiles and accident records, particularly where they are able to offer assurance that they might recognise minimum standards of risk management and safety management. Some notice may be taken of new legislation introduced

by Belgium in 2006 which will require businesses with accident rates and severities which are above certain thresholds (at least five times the national average) to pay a *cotisation de prevention forfitaire* or fixed preventative contribution to their insurance companies of somewhere between €3,000 and €15,000. The insurer will be required to spend the contribution on accident prevention measures by the employer concerned.

Rehabilitation

1.7 Another fertile area for development which employers and the employers' liability system historically not supported as fully as it might is in the provision of services and support for the treatment and rehabilitation of accident victims.

The TUC has called for a National Rehabilitation Committee to be set up to oversee the broadening of rehabilitation provision and this has been welcomed by insurers. Insurers and organisations representing lawyers who deal with personal injury claims have also publicly supported the *Rehabilitation Code* (BICMA, 2002) which is designed to encourage early assessment of whether an insured person would benefit, and the production of an independent rehabilitation needs report which it is agreed neither side will seek to use in any subsequent litigation. While there has been recognition of the value of rehabilitation, and large employers increasingly view this as a natural part of occupational health services they provide, it is fair to say that most personal injury claims still proceed without much serious consideration rehabilitation the full benefits are not yet being seen (IUA, 2002).

As will be seen in Chapter 7 the issue of rehabilitation has begun to come to the fore as the Disability Discrimination Act 1995 has affected employment law. The need to retain and if necessary make reasonable adjustments for employees suffering from work-related injury or ill health now needs to be considered very carefully to avoid breaching this Act. Reasonable adjustments could comprise:

- allowing an employee time off for rehabilitation or treatment;
- making adjustments to premises;
- making equipment modifications;
- changing the employee's normal working hours or allowing home working;
- allocating some of an employee's duties to another colleague;
- transferring the employee to fill a vacancy.

Accountability or compensation culture?

1.8 Pressure has been growing for more and more accountability for employers, especially in the wake of major transport accidents in the UK. This is by no means a modern phenomenon. The course of the industrial revolution can be charted by the gradual creation of new legislation and the adoption of the common law aimed at providing basic protection under the law for employees and the public. Health and safety legislation has extended since to issues such as openness with employees and safety representatives, disclosure of information to the authorities (often without safeguards against self-incrimination), obligations to notify the authorities soon after an accident has occurred, and other obligations to co-operate with inquiries and investigations. Nowadays calls for more accountability are in reality targeted much more focused agendas of personal in terms of accountability of senior managers, and calls for harsher penalties which inflict lasting effects on companies' finances and reputations. In 2006 these emerged as a major policy issue with the publication of a major consultation on proposed new penalty regimes (Macrory, 2006) considering with the introduction of the corporate manslaughter Bill into Parliament which many MPs wished to see create new offence for directors too.

The notion of accountability – and how it can be increased and made more visible – underlines much of the "*Revitalising*" strategy. This has led for example to the expansion of the HSE's "name and shame" website so that it publicises details of not just conviction and fines, but also improvement notice and prohibition notices served by the HSE. Another development with less punitive objectives has been the guidance published and actively promoted to large companies by the HSC (HSE, 2001b). This guidance advises publication by companies on:

- health and safety policy details;
- significant risks and the systems in place to control them;
- health and safety goals, with reasonable targets;
- a report on progress towards the goals in the reporting period;
- data on health and safety performance;
- details of any fatalities and the steps taken to prevent any recurrence;
- numbers of work-related health problems first reported in the reporting period;
- details of enforcement notices and convictions, and remedial action taken;
- the total cost of work-related illness in the reporting period.

Some other significant changes taking place in the litigation system have however caused widespread concern about accountability being taken to extremes, with

someone having to be found at a fault for every misfortune which life brings. Measures directed towards reforming and making the civil justice system more accessible have been beneficial to many people, but have come at a cost. Pre-action protocols which require defendants to incur costs investigating claims that may be of little value, the relaxation of restrictions on lawyers, advertising by unregulated claims companies, having a stake in the success or failure of their customers cases, and the introduction of lawyers' success fees as a new litigation funding mechanism have given rise to fears of the appearance of US-style speculative litigation practices starting to take root.

Views have polarised on whether these changes have in reality led to a "compensation culture". The TUC points to data which indicate that surprisingly less than only around 10 per cent of people who are injured at work actually receive compensation. The government points to numbers of claims reaching court or being notified to the Compensation Recovery Unit (which is meant to be obligatory) which went down by 5.3 per cent between 2000 and 2005.

Prime Minister Tony Blair recognised the elusive nature of the truth of the problem in a speech in May 2005 where he pointed out the UK's favourable cost of claims compared to most countries and said:

> "… But the facts too often do not prevail. You may recall the stories of the girl who sued the Girl Guides Association because she burnt her leg on a sausage or the man who was injured when he failed to apply the brake on a toboggan run in an amusement park. Neither of these cases produced big compensation awards in the courts. But this is not the impression that is left. The headlines have an after-life. They leave behind the sense that, not only are such cases being brought all the time, but that huge sums of money are being wasted. This impression, in turn, has genuine effects. Public bodies, in fear of litigation, act in highly risk-averse and peculiar ways. We have had a local authority removing hanging baskets for fear that they might fall on someone's head, even though no such accident had occurred in the 18 years they had been hanging there. A village in the Cotswolds was required to pull up a seesaw because it was judged a danger under an EU Directive on Playground Equipment for Outside Use. This was despite the fact that no accidents had occurred on it."

Perceptions of more active enforcement activity and frequent prosecutions – again not entirely borne out again by the facts as shown in published statistics – have also fuelled disquiet and popular criticisms of the "elfansafety brigade". In 2006 the

Chairman of the HSC Bill Callaghan was driven to join the debate, when in launching a revised risk management guide he stated publicly that:

> "we must, and will, promote the sensible management of risks that protects people from real harm and suffering, but avoids bureaucratic back covering. My clear message is that if you are using health and safety to stop everyday activities – get a life and let others get on with theirs."

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2 Accident causation

In this chapter:

Definitions and terminology

Dictionary and technical definitions

2.1 Definitions of incidents and accidents vary widely according to industry and sector: an incident in one industry may be regarded as an accident in another. Further, definitions of incidents and accidents vary greatly according to whether the terms are used in everyday life, or whether the terms are used in a technical sense by health and safety practitioners or managers, reliability engineers, lawyers or safety psychologists. Before considering what causes accidents, it is necessary to spend some time considering what they are.

The *Concise Oxford English Dictionary* defines an *incident* as "an event or occurrence; an instance of something happening" (2004). This definition says only that an incident is a circumstance in time, and nothing about whether the incident is noteworthy or insignificant, unexpected or anticipated, how the event came about, and whether there was the potential for serious harm.

The same source defines an *accident* as "an unfortunate incident that happens unexpectedly and unintentionally; something that happens by chance or without

apparent cause". In this case, the definition indicates that an accident is a random and unexpected negative event.

Neither of these definitions would be accepted by a technical specialist, because they do not provide sufficient information on the true nature of incidents and accidents.

In a technical sense, and especially within safety critical industries and/or high reliability organisations, these terms have more specific meanings. As such, the definitions used often incorporate detailed criteria which a given event must meet in order for the term to apply. For example, the International Civil Aviation Organization (ICAO) provides an internationally agreed convention for investigating civil aviation accidents (2001). The ICAO convention contains a whole chapter on definitions, and the definition of an aviation accident is as follows:

> "An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which:
>
> (a) a person is fatally or seriously injured as a result of
>
> – being in the aircraft, or
>
> – direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or
>
> – direct exposure to jet blast,
>
> **except** when the injuries are from natural causes, self inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew: or
>
> (b) the aircraft sustains damage or structural failure which:
>
> – adversely affects the structural strength, performance or flight characteristics of the aircraft, and
>
> – would normally require major repair or replacement of the affected component,
>
> **except** for engine failure or damage, when the damage is limited to the engine, its cowlings or accessories: or for damage limited to propellers, wing tips, antennas, tires, brakes, fairings, small dents or puncture holes in the aircraft skin: or
>
> (c) the aircraft is missing or is completely inaccessible"
>
> ICAO (2001, p. 1-1)

Similarly, the aviation industry defines an incident as "an occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation" (ICAO, 2001, p. 1-1). This definition of an incident suggests that it is an event which may have had the *potential* to be more serious.

In transport, the Air Accident Investigation Branch (AAIB), Marine Accident Investigation Branch (MAIB) and recently established Rail Accident Investigation Branch (RAIB) draw distinctions between incidents and accidents in order that investigative resources can be allocated accordingly. Accidents are certainly investigated by the relevant authority, while incidents *may* be investigated by the appropriate authority if the occurrence is relevant to the entire sector. Incidents are more likely to be investigated locally, probably by the airline, shipping company or train operating company concerned. Near misses, or "close shaves", are often unreported in many industries, but in the aviation, marine and rail industries there is the option of reporting them to a confidential or anonymous reporting scheme. Such schemes can be useful where personnel want to report a safety concern or near-miss experience, but do not want to draw the attention of line management to their actions, for understandable reasons.

Health and Safety Executive definitions

2.2 The Health and Safety Executive (HSE) also uses specific definitions of incidents and accidents. The HSE uses the term "adverse event" to include both accidents and incidents. An accident is defined as "an event that results in injury or ill-health" (HSE, 2004, p. 2), while an incident is classified as a near miss or an undesired circumstance. A near miss is "an event that, while not causing harm, has the potential to cause injury or ill health" (HSE, 2004, p. 2). Reportable dangerous occurrences under RIDDOR are defined as near misses in this context. An undesired circumstance is defined as "a set of conditions or circumstances that have the potential to cause injury or ill-health" (HSE, 2004, p. 2). The HSE definitions focus on the potential of an event to cause ill health, injury or death.

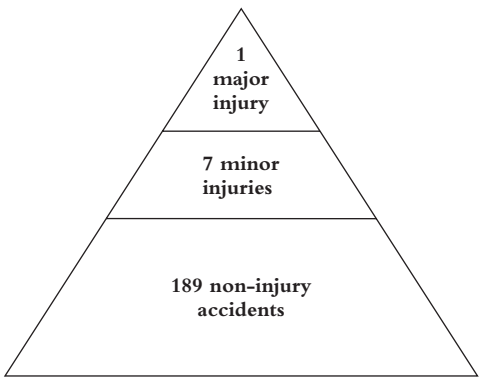
Near misses, incidents and accidents

2.3 It is clearly reasonable to provide definitions based on drawing a distinction between an event that harms a person, or a number of people, and one that damages only plant or equipment. It is possible that events may occur which cause significant damage to plant and equipment, and yet injure no one. There may still be advantages for an organisation in classifying such events as accidents, and investigating them thoroughly; it may be possible to take preventative action and avoid similar failures or damage in the future.

Investigations of more minor incidents and "near misses" – events that may be regarded as a "close shave" – may also be useful. Both incidents and near misses may provide valuable information if investigated, because the aetiology of near misses, incidents and accidents is believed to be similar. That is, these events are often believed to have similar causes. However, minor events occur much more frequently than major ones, and therefore investigation of near misses and incidents may allow for corrective action to be taken *before* a similar set of circumstances leads to a more serious accident. Some authors would suggest that such events provide "free lessons" in organisational safety and safety deficiencies. This is why confidential reporting schemes are used in several industries to encourage reporting of near misses and incidents. Such schemes do have their limitations, but they may help organisations to capture this type of safety information in an anonymous format, without reliance on the formal management reporting schemes which employees can be reluctant to engage with.

As an example of the relative frequencies of near misses and incidents to accidents, consider the data in Figure 2.1. This shows the ratio of major injury accidents to minor injury accidents and non-injury accidents, from HSE statistics.

Figure 2.1: Relationship between major injuries, minor injuries and non-injury accidents (adapted from HSE, 1997, p. 8)



In reality, whatever definition is selected, it is clear that accidents are events with undesired outcomes, which could include injury or fatality to persons, and/or damage to plant and/or equipment. So, in this chapter, the term "accident" will apply to events which meet this criteria, whether they might be known as incidents or accidents in other settings, and whether they may be called individual, organisational or system accidents in other texts.

Accident outcomes

2.4 Defining accidents in terms of direct outcomes such as injuries, fatalities and losses to equipment and assets oversimplifies the "result" of an accident. It must always be remembered that, in addition to the injuries, fatalities, and loss and damage of physical assets, there are a wide range of additional outcomes associated with accidents. Generally, the more serious the accident, the wider the repercussions, but even relatively "minor" accidents can have profound personal effects.

Following accident involvement, an employee will suffer loss of confidence, and his or her relationship with his or her colleagues and supervisor will shift. If an injury has been sustained, then there may be long-term workplace consequences. Economically, injury and ill health can place additional financial burdens on individuals and families, at a time when these resources may already be stretched. Changes in mobility, fitness or health resulting from the accident will also influence life satisfaction and well-being. Behavioural and psychological changes resulting from the accident may be of long-term consequence. The nature of family relationships and relationships with friends may change (Adams et al., 2002; Cormack et al., 2006; HSE, 2006).

For the organisation, additional negative outcomes include the direct economic costs of loss of working time and production; the loss of future contracts and possible threats to the continuity of the business; increased insurance risks and premiums; and loss of reputation and goodwill, all of which can be difficult to quantify. In addition, and depending on the severity of the accident, there may also be far wider social and environmental costs which result. With very serious accidents, the social and environmental consequences can be extreme, and may persist for many years, or even decades.

Once an event has occurred, and depending on the timescales involved, there may be time to mitigate for an unfolding accident. Fires can be put out, plant can be shut down and people can be evacuated. These actions may reduce the severity of the outcome of the accident, but they do not necessarily downgrade it to a more minor event – the *potential* for very serious outcomes was always present. This is another reason why defining an accident based solely on its outcome can be misleading, because doing so fails to take into account any deliberate interventions taken to minimise the impact of the accident. Primary safety involves reducing the probability of accidents occurring in the first place. Secondary safety initiatives are concerned with reducing the probability of harm and damage from accidents once they have occurred. Both primary and secondary safety are vital in minimising overall losses from accidents, and hence accident management and emergency planning strategies are also important considerations.

Accidents and chance

2.5 More seriously, lay definitions of the term "accident" imply that these events are somehow caused by blind or random chance; as if they were an act of God, a total fluke, a freak occurrence. In fact, this is often far removed from the truth. Although every accident is unique, the study of accidents in a wide range of sectors has shown that there are certain commonalities, and it is therefore possible to formulate some clear conclusions about organisational and system safety.

Table 2.1: Chance, outcome and public perceptions

A specialist radiation contractor was engaged to transport decommissioned equipment from a cancer treatment unit in Leeds to Sellafield for disposal. A specially constructed 2.5-tonne container was used to carry the contaminated material on a lorry for 130 miles. Travelling by road for 3 hours, the material reached Sellafield, where it was discovered that radiation levels were up to 1,000 times greater than what would normally be considered a very high dose rate.

Investigation revealed that a shield plug – a vital part of the approved packaging – was missing from the flask. The radiation fortunately took the form of a narrow beam, which had been directed towards the ground throughout the trip. Had it been emitted horizontally, dangerous radiation would have been emitted for 980 feet from the flask.

It was "pure good fortune" that no one was exposed to dangerous radiation levels (BBC, 2006a). The HSE and Department for Transport brought a prosecution because they regarded it as a serious incident. Clearly, the outcome could have been much worse – and would have "upgraded" the event to an accident. However, the *potential* for harm was always present, and only chance prevented this situation from being much more serious.

Public perceptions of nuclear risks are typically influenced by the "unknown factor" and the "dread factor". The unknown factor describes the extent to which radioactive effects are unobservable and delayed, and the extent to which the risks are unknown to science. The dread factor relates to the belief that nuclear risks are fatal, uncontrollable, catastrophic, and will remain involuntarily present for future generations. Incidents and accidents in the nuclear industry are regarded as particularly "doom-laden" by the general public (Slovic, 1987). Hence, reports that contractor employees had a "relaxed and cavalier" approach would have been of particular concern to the general public.

One of the key findings has been that there is very rarely a *single* cause of an accident. A single act, event, omission or failure very rarely "causes" an accident. Accidents are complex combinations of multiple causal and contributory factors. A causal factor is a factor that has a direct, one-to-one link to the accident. If a causal factor is removed from a sequence of events, the accident does not occur. A contributory factor is a factor with a probabilistic relationship to the accident – removing a contributory factor reduces the chances that an accident will occur, but does not directly prevent it. Hence, accidents are not random, but are the culmination of a complex series of causal and contributory acts, events, omissions and failures.

Some of the failures which cause an accident will be active failures, meaning failures at the front end of operations, which often have an immediate effect. Others will be latent failures, "resident pathogens" (Reason, 1990), which lie dormant, unnoticed and unrecognised, until an unforeseen circumstance reveals the gap in the safety defence. Typically, the unforeseen and unpredictable interactions between events and circumstances mean that it simply would not have been possible to predict the accident in advance (Perrow, 1997).

In reality, if it were possible to predict the nature, outcome, location and timing of an accident with any degree of accuracy, then organisations and systems, and the people who work within them, would never have them in the first place. Unfortunately, the advantage of hindsight, which is conferred automatically on all accident investigators by virtue of their role, sometimes obscures this very simple fact.

In addition, luck does play a role in determining the outcomes of adverse events. It may be a cliché, but luck comes in two flavours: good luck and bad luck. The causes of an incident and a more serious accident may be identical, but perhaps because of a stroke of good luck, the more serious accident outcomes were averted. As an example, consider a failure to the main rotor gearbox on a helicopter. If a helicopter's main rotor gearbox fails a few seconds after take-off, then the outcome will probably be a premature landing, with minimal damage and minor injury. The same failure, with absolutely identical causes, but occurring at 6,000 feet above the North Sea during winter conditions, will have very different and far more serious outcomes.

If it is merely providence which has prevented an incident from becoming an accident, then there is clearly a case for conducting an investigation. "Incidents that by chance fall short of developing into major accidents should attract an equal intensity of investigation if they are to serve as sources of insight into causes and allow future accidents to be prevented that may not benefit from the same fortuitous chance" (RAE, 2005, p. 7).

Accident phases

2.6 Finally, it is also clear from the study of many accidents that they move through a common set of phases. Although the details will vary depending on the regulatory context, sector, organisation and individuals involved, accidents begin with an initiating event(s). This event is what starts the accident, and it can be a technical failure or an unsafe act of a person. Sometimes, a series of technical failures and unsafe acts are the immediate causes. These are the issues which will typically occupy lawyers for months after the event, prosecuting and defending, and determining fault and liability to address compensation and disciplinary issues.

As already mentioned, there is sometimes a short period after the initiating event(s) in which the situation could potentially be redeemed. This is known as the "amelioration phase". If this opportunity is available, it depends critically on the operator or supervisor recognising that something is amiss, making the correct diagnosis and instigating the correct recovery processes. Given that the time available may be limited, and that the situation confronting the person may be highly unfamiliar, this may be highly unlikely. The danger release phase of the accident is where the accident "happens", which may or may not be the same moment in time as the harm release phase. The harm release phase is where damage to people, plant and assets actually occurs – this may occur shortly after the danger release phase, or it may begin (and continue for) some time later.

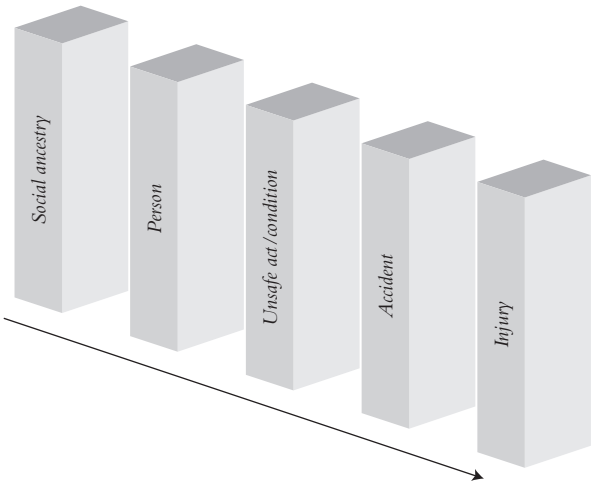
Early theories of accident causation

Domino theories of accident causation

2.7 One of the earliest formal theories of accident causation was developed by Heinrich in 1931. He analysed 75,000 accident reports from companies insured with Travelers Insurance Company and developed the "domino" theory of accident causation (cited in Bamber, 2003). Heinrich concluded that 88 per cent of all accidents were caused by unsafe acts of people, 10 per cent by unsafe conditions and that 2 per cent were caused by acts of God (e.g. "natural" accidents).

Based on his findings, Heinrich identified five factors in the accident sequence, shown in Figure 2.2. These are social environment and ancestry, fault of the person (carelessness), unsafe act and/or mechanical/physical conditions, the accident, and finally, the injury itself. Social environment and ancestry included the social learning of custom and practice in the workplace, as might be evidenced in an apprentice learning from his master. The "carelessness" factor included negative personal

Figure 2.2: Heinrich's domino theory of accidents



characteristics of the individual; however they might have been acquired. Unsafe acts or physical conditions were the errors or technical failures, which led directly to the accident which resulted in the injury. In essence, removal of the unsafe act or condition would prevent the accident.

Heinrich's theory of accident causation is a simple linear sequence of events. It explains "what happened", but it doesn't provide much information on why the accident occurred. In addition, the model essentially lays accidents firmly at the door of the unsafe act or mechanical condition – without examining any underlying or contributory factors. This early theory has been superseded by more sophisticated theories of accident causation, but Heinrich's terms "unsafe act" and "unsafe condition" are still very much in use.

A more complex domino theory suggests that adverse events have immediate causes, underlying causes and root causes (HSE, 2004). The immediate causes are the actual agents of injury or ill health – the blade, the substance or the fumes. The underlying causes of a workplace accident are the unsafe acts and unsafe conditions which gave rise to the immediate cause, such as where a guard is removed, the window closed or the ventilation switched off. The root causes of the adverse event are the failures from which all other failures stem. For example, a failure to adequately assess risk, incomplete analysis of training needs, lack of monitoring and control. Elimination of underlying and root causes potentially prevents a whole series of adverse events, while addressing immediate causes would only prevent recurrence of the specific

adverse event which arose. This model is more sophisticated than that proposed by Heinrich, but many safety and accident theorists would nevertheless dispute the existence of a "root cause" as being too simplistic.

Accident proneness and accident liability

2.8 Heinrich's concept of carelessness almost "blames" the operator for having the injury. The more modern terms of "accident proneness" and "accident liability" are sometimes used in the same way. Accident proneness is defined as a relatively enduring characteristic of an individual which predisposes those possessing it to be involved in a higher than expected number of accidents, compared to other people in the same situation. In contrast, accident liability is the propensity for any individual to be accident involved, and it includes situational, personal and task-related factors. A great deal of research has been conducted into individual differences in accident proneness and accident liability. However, there are many methodological difficulties in conducting research in this area.

One of the main difficulties is in ensuring that comparison groups are equally matched for their exposure to the risk. For example, in examining accident rates among occupational drivers, how can a researcher be sure that an individual's higher accident rate involvement is not simply a result of spending more miles or hours behind the wheel, or of driving different types of vehicle on different types of road? This distinction would be necessary to distinguish accident proneness from accident liability. Further, if accident proneness is a relatively enduring characteristic, then people with high levels of accident involvement at work should also experience higher accident rates in other areas of their life – and controlling for exposures to risks outside work makes research of this nature even less reliable.

A comprehensive review of the research literature on accident proneness recently concluded that "there is little evidence to support a grand theory of accident proneness" (Lawton & Parker, 1998, p. 41). And while accident liability does appear to differ between individuals, this could of course be due to many factors other than "accident proneness": factors associated with the task and the situation will play a role. Research has shown that individual differences in accident involvement fluctuate over time – which has led one author to conclude that the "accident liability" club has very few members, and an ever-changing membership list (Reason, 1990, p. 199).

Because of these issues, strategies which aim to reduce the risk or frequency of accidents by identifying those who are particularly prone or liable to accidents are

unlikely to be very effective. If it were possible to reliably and consistently identify "accident repeaters", then organisations would be able to take appropriate action. Possibilities could include selection screening (such as psychometric testing) to avoid offering employment to higher-risk individuals, or retraining (and maybe ultimately redeploying) those personnel with poor accident involvement records. This is known as the "bad apple" theory of accidents, and although intuitively appealing, the reality is not so simple. An example provided by Hopkins (2006) will serve to illustrate this point.

Imagine that a company has 1,000 employees. In any 12-month period, most will have no workplace accidents resulting in injuries, although a small proportion may have one injury (say, 16.4 per cent). Another 1.6 per cent may have two injuries and 0.1 per cent may have three injuries. So in total, 819 employees will have had no injuries (although a high proportion of these may have had near misses or close shaves), 164 will have had one injury, sixteen will have had two and one employee will have had three. Disciplining this one individual as an "accident repeater" or "bad apple" does not take into account the fact that some of the injuries sustained may be due to organisational factors which are beyond the individual's control, or even due to chance. How many of the 819 uninjured employees escaped accidents through luck alone? A much longer period of time would be required to identify "accident repeaters" with any degree of confidence, since the relative rarity of injuries and accidents means that the data are limited, and conclusions drawn from small amounts of data may well be spurious.

Taken to the extreme, this approach would mean that organisations would only eliminate "bad apples" if it could be shown that no organisational or chance factors contributed to their own injuries or accidents, and to the absence of injuries and accidents among their colleagues. In reality, because multiple factors cause accidents, including organisational issues and chance, this is extremely unlikely to be the case. However, it is certainly true that organisations can screen out individuals who report a higher likelihood of risky behaviour. For example, people who report enjoying driving at speed may not be the best recruits to driving vacancies in a road haulage company, since they may have a higher frequency of optimising violations (see page 33) compared to other drivers.

Nevertheless, the *overall* level of risk to an organisation which can be attributed to recruiting such individuals is likely to be small for two reasons. Firstly, not all instances of speeding result in accidents. This means that there is no direct, 1:1 correspondence between speeding and road accidents. If there were, then very quickly everyone would learn never to speed because of the absolute certainty of accident involvement. Secondly, although speeding reduces the time available to the driver to perceive, identify and appropriately respond to hazards, and also potentially worsens

the consequences of any accident that does occur, it is often not the sole cause of occupational driving accidents. Additional factors could include poor weather conditions, which could decrease adherence and lead to reduced handling capability, or fatigue and tiredness, which may be related to hours worked, distance driven, time of day and driver scheduling. Further, some drivers may fail to perceive, identify and appropriately respond to hazards even when driving within the speed limits. It is likely that all of us have done this at some point or another, although we may normally attribute the problem to the other driver and not ourselves (see Table 2.2).

Table 2.2: Attribution theory

Scenario 1: Imagine that you are driving in the middle lane on the motorway, overtaking some traffic in the left-hand lane. However, the car in front of you is moving very slowly, and it looks as if he is just sitting in the middle lane. You prepare to pull out, into the outside lane, to overtake him. As you do so, you glance over your shoulder and spot another car in your blind spot, driving very quickly in the outside lane. The driver beeps his horn at you to warn you that he is there, and you quickly pull back into the middle lane, swerving slightly. What is your first reaction? Probably that you don't know where he came from, that he appeared from nowhere, and that you can't believe that he has the nerve to honk at you!

Scenario 2: Imagine that you are driving down the middle lane of the motorway, with a fair distance between you and the car in front. You suddenly notice the car in front pull out, and then swerve violently back into the middle lane as a car in the outside lane speeds past, beeping his horn. What is your first reaction? Probably that the driver in front was an idiot not to check his blind spot, and that there could have been a collision.

In the first scenario, you are the driver who pulled out without checking your blind spot, but you attributed the near miss to the situation you were in. In the second scenario, which describes an identical situation from a different perspective, you probably attributed the near miss to the driver in front. This is a common phenomenon – we attribute our own near misses and failures to the situation we were in. However, the near misses and failures of others we almost invariably attribute to them personally. The reality is that a combination of factors will determine how we behave in a given situation – but we tend to judge other people quickly, without placing enough emphasis on the situation they were in. This is worth remembering when you find yourself thinking that someone is "accident prone".