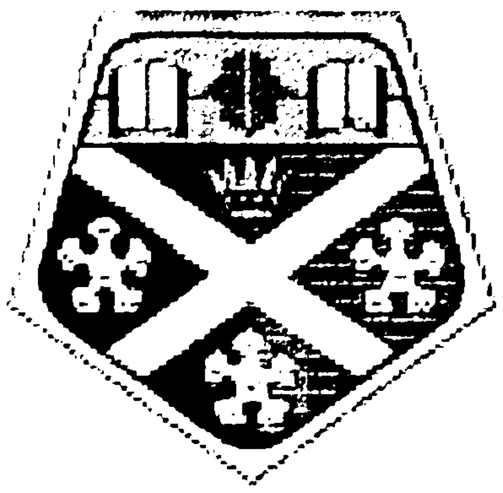

DEVELOPMENT OF A PRACTICAL AND MEASURABLE HEALTH AND SAFETY MANAGEMENT SYSTEM

Eleanor Forrest

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Department of Naval Architecture and Marine Engineering

A Department of the Universities of Glasgow and Strathclyde

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ABSTRACT

This study was performed within a major drinks company in the UK. The overall objective was to develop a formal, structured and measurable safety management system appropriate for the company. The system had to be effective for all sites and operations and be consistent with developing international standards. A comprehensive review of performance measurement, both positive and negative, was carried out. Measurements had to be practical and useful within the operating environment - showing real, understandable change over short periods of time. The study also considered the roles of individuals in relation to safety and pursued the active engagement of employees in the safety program.

The success was that the profile of safety management was raised beyond recognition within the company; and was eventually integral to the way that the company managed its business. The system provided a mechanism to allow the company to progress.

The study demonstrates what can be done, and what cannot. An interesting by-product of the study is that by changing hard systems, some soft factors have also changed. The study was intended to impact upon the core safety management systems and control measures, but over the period of study some people have changed their attitude and perhaps changed their behaviour.

The main constraints to the study were that production came first and that senior management constantly changed. The amount of money available to spend on the improvement of safety standards was limited and also secondary to the requirements of production. Within the company there was almost constant change of personnel and operating structure. This problem was countered in part by the development of consistent, documented safety management systems. It was clear, however, that lasting improvements in safety can only achieved by the involvement of the actual work force.

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1.1 INTRODUCTION

This work records research in action. The author was attached to a major drinks producer, J&B Scotland, as a researcher, was recruited by them and was until February 2000, Risk Manager responsible for risk management including safety at all sites, and the health and safety of 740 employees. This work spans a period from January 1994 until the end of 1997: from a time when a major change in safety management and processes was conceptualised in J&B Scotland, to a date when merger of the organisation's interests with another major producer scores a convenient line under the process of change.

This work is also a record of success. Not every initiative taken succeeded, not every proposal proved practical to implement, but the management of health and safety at J&B was modernised. Processes were defined, standardised and moved towards the end goal of being fully managed. At the same time, responsibilities were emphasised and new techniques implemented to drive behaviour towards a safer norm.

It is not possible to record all the actions taken and the general day to day work of the safety manager must be understood as the foundation for the work reported here. Issuing safety clothing, organising purchasing deals, involvement in the site management team and negotiating redundancy with departmental staff are examples of interruptions and pressures that make it difficult to keep an eye on the wider goal. Safety management is still like swimming in warm treacle, but at J&B Scotland it became, at least, no longer a swim against a strong tide.

1.2 J&B SCOTLAND'S HISTORY

J&B Scotland was a subsidiary of International Distillers and Vintners Ltd (IDV), the drinks sector of Grand Metropolitan plc., before merger with Guinness PLC in

1997 to form Diageo. IDV was a UK based multi-national that owned a range of food companies including the Burger King chain and Pillsbury, and leading drinks brands such as Baileys, Cinzano, Smirnoff and an extensive range of Scotch Whisky. This research study focuses on J&B Scotland before structural change as a result of the merger impacted the organisation.

The Headquarters of J&B Scotland were at IDV Operations on the J&B Scotland premises in Dumbarton, one of seven operational sites in Scotland wholly owned by the company. The site, also known as Strathleven, was previously a contract bottling plant used by IDV but owned by Strathleven Bonded Warehouses Ltd.. IDV at that time owned a warehouse and filling/blending plant at Blythswood, the Bonhill warehouses and four Distilleries. In 1987, Strathleven Bonded Warehouses was taken over by IDV and the combination of the 7 sites was known as J&B Scotland Ltd. This take-over date provides a reasonable foundation point for a history of safety management.

1.3 J&B SCOTLAND'S ACTIVITIES AND SITES

J&B Scotland's principal activities are the production, maturation, blending and bottling of Scotch Whisky and the blending and bottling of other spirits such as Smirnoff Vodka, Malibu Rum and Archers Peach Schnapps.

They own and operate four malt whisky Distilleries at Auchroisk, Glen Spey, Knockando and Strathmill; all of which are in the Speyside region of the North of Scotland. A total of approximately 110 employees are based at the Distilleries, the majority at Auchroisk the largest production site and warehousing complex. The Distilleries work on a 24-hour ongoing shift basis, with a maintenance shut down period of 2 weeks per year.

Raw materials are delivered to the Distilleries for Distilling in pot stills. The process is almost fully automated, with Stillroom operators overseeing the operations. The work performed at these sites is primarily warehousing, process control, engineering

and maintenance and as distilling operations are relatively hands-off for employees, the main risks are created during cask handling, maintenance operations and coopering. Spirit is exported in cask or bulk spirit tanker by road. Fire is the primary major hazard, although flooding has produced the greatest commercial loss in recent years.

Maturation and cask storage of Scotch Whisky is carried out principally at Auchroisk, Blythswood, Bonhill and Strathleven although the three remaining distilleries also store whisky in casks. Blythswood is a blending and maturation site, with approximately 80 employees in total. It operates on a single shift basis with overtime. The spirit is delivered to the site by road tankers for maturation or blending on site. Whisky is transferred from incoming tankers from the Distilleries to casks for maturation. It is then decanted from matured casks for blending and eventual transfer by tanker to Strathleven for bottling. Tanker drivers are based either at Blythswood or Auchroisk. The spirit is unloaded from the tankers at each site via a tanker bay. A high latent fire hazard exists at all spirit storage sites and fire and explosion risks exist whenever spirit is transferred. The main injury risk to employees during operations at Blythswood is, however, from handling of casks.

Bonhill is an unmanned warehousing site used for maturation and cask storage. When cask movements are required, personnel from Blythswood are transferred to the site. In the main, operations involve cask movement such as cask loading, unloading and racking and maintenance work. Like the other sites, the major hazard is that of fire and explosion as a result of high strength spirit storage and transport. The main injury risks to employees working on the site, however, tend to be from handling and risks resulting from maintenance work.

The majority of bottle filling and packaging operations are performed at Strathleven, although approved sub-contract companies undertake a small percentage of packaging. 550 employees are based at Strathleven, with a fluctuating number of temporary employees brought in to cover seasonal fluctuations in production. At the start of the study in 1993 there was a production day shift and maintenance back

shift in operation. The site then moved to a single day shift for production, with evening and weekend overtime. The excessive levels of overtime then led in 1997 to the site implementing a three shift system for production: early, day and back shift, with weekend overtime during high periods of production and stock building.

At Strathleven the raw materials are transported to the site by road haulage - whisky, neutral grain spirit, sugar, flavours, glass, cardboard and closures - and stored to be used in scheduled production. The materials are then delivered to one of the production lines by pipeline or forklift truck to meet the requirements of an order. The production lines are semi-automated, with line operators controlling quality and ensuring production falls within specifications. The finished product (in cases) travels from the production line via a conveyor system to be palletised and wrapped. The final product is stored in racks and stacks in Finished Goods warehouses awaiting transfer to a trailer or container for distribution. At the outset of the study there were 19 production lines on site, but in 1997 there was a significant investment programme which reduced the number of lines to 13 by improving the capability and flexibility of the remaining production lines. The new lines produced spirit at higher speed, and were more fully automated. The plant produced around 14 million cases of spirits per year at normal production rates.

There is a greater variety of different risk exposures created by operations at Strathleven than at the other sites due to the diverse nature of its activities. The most likely exposure in the materials and bottling areas is that of cuts due to materials handling and cleaning operations. Engineering and electrical maintenance of plant, as always, is hazardous to those involved and to others and, in addition, slips, trips and falls, manual handling and exposure to excessive noise levels are significant risk exposures on site. Increasingly on all sites, non-routine operations are performed by sub-contractors, and this creates risk exposures for the contractors and for J&B's employees.

1.4 THE STUDY

1.4.1 SPECIFICATIONS FOR STUDY AND INITIAL REVIEW

Concerns had been raised that the safety control systems in place at J&B Scotland were not effective, but other than bringing in additional resources that were not certain to be effective, no practical long term solutions had been identified. The research study was initiated as a response to real issues within the company and the demand for effective solutions.

Money could have been spent to respond to these safety issues but would not necessarily have identified and resolved the root causes and, therefore, might have had no impact on safety standards. J&B Scotland required, as an operating company and cost-centre, a cost effective solution to the problem. The solution had to be practical in terms of time and resource (financial and human), functional constraints, and most importantly realistic on the basis that *J & B is a spirits production company that operates safely not a safety company that makes spirits*. Any solution that was to be implemented had to be practical in a real working environment, rather than in the theoretical. In summary: the study aimed to consider all options, test possible solutions and then identify what worked, what did not work, and propose what was reasonably practicable to implement.

At the outset of the study reported here, an initial status review was conducted to evaluate the current standards and styles of health and safety management within the company. The status review aimed to identify the existing issues and defects and determine a baseline level of performance against which progress could be compared.

The initial status review consisted of various components:

i) A health and safety audit to determine deficiencies (and attributes) in terms of management systems, physical evidence and documentation.

ii) Analysis of accident data to determine the consistency of information, level of reporting, actions, patterns, trends and benchmarking.

iii) Analysis of a study by Strathclyde University to determine other factors and findings.

iv) Evaluation of physical evidence across all 7 sites, and a comparison of findings.

The results of the initial status review can be summarised as,

- There were no formal safety management systems and there was inadequate documentation of health and safety
- There were inconsistencies in the treatment of health and safety between sites and standards varied within and between sites
- Each site had different policies, procedures and related documentation that created gaps and overlaps in coverage and inconsistency of standards
- Health and Safety was seen as the responsibility of the Health and Safety Manager, not of the individual.
- Health and Safety performance was measured in negative terms only and inconsistently, using a single measure - the number of accidents that occurred per month.
- There was no continuity planning within the management of safety

1.4.2 OBJECTIVES OF THE STUDY

After these main deficiencies were identified, the task was to consider what would be required to correct them and to establish proactive, positive safety management.

The objective of the study was taken to be the development and implementation of a formal, structured, but practical and measurable health and safety management

system appropriate for the company. This system had to be suitable and effective for all sites and operations and, furthermore, was to be developed with the objective of integration into the ISO Quality Management system that was already in place for products. The systems had to be consistent and appropriate for effective integration into a Group-wide Total Quality Management environment within the corporate Business Management System.

It was determined that, alongside the management system, a comprehensive system of performance measurement, incorporating both positive and negative performance measures should be developed, to provide a system for ensuring continuous improvement. Again, the measurement system had to be practical and workable within the operating environment, although not all measures would necessarily be performed locally.

The study also aimed to consider the role of individuals within a working environment in relation to safety and a principal objective was pursue the active involvement and participation of employees in safety management.

The safety management system and performance measures developed were then to be evaluated for their effectiveness and, finally, the output was to be a comprehensive, workable safety management and performance measurement system.

1.5 THE DEVELOPMENT OF SAFETY MANAGEMENT IN J&B SCOTLAND

1.5.1 SAFETY MANAGEMENT (1977-1992): ITS RELATIONSHIP TO OTHER MANAGEMENT PROCESSES AND THE REASONS FOR CHANGE

In 1977, Strathleven Bonded Warehouses recruited its first Health and Safety Manager (W Adamson), who had, in addition, responsibility for security on the site. This recruitment was in response to the requirements of the Health and Safety at Work Act 1974. After the 1987 take-over by IDV Operations and the setting up of J&B Scotland in its final format with 7 sites, he was given responsibility for health,

safety and security at all sites and reported to the Personnel Director. Unfortunately, there was a clear conflict of personalities and issues in this structure.

At this time Personnel Management at J&B Scotland could be fairly said to be in transition. Positive steps were being taken towards some of the features of 'hard' Human Resource Management, but the system was essentially tightly controlled and hierarchical. The ethos was centred on management from the top and it was on the crux of devolution of responsibilities that conflict existed - Personnel insisting that their control and involvement in detail be extended to the Health and Safety function.

In 1989, a Health and Safety Advisor was recruited for the 4 Distilleries, and a Security Manager at Blythswood. The Health and Safety Manager for Strathleven had taken responsibility for Blythswood (and notionally for the Distilleries) and he now transferred responsibility for all security issues to the new Security Manager. The Health and Safety Manager's role was, by this time, essentially to police safety on site, rather than delegating responsibility.

The tiger was caged and remained the sole responsibility of its keeper with the audience observing from within the cage! The difficulty was that with one keeper and 3 key sites, plus the Distilleries, the task of policing and enforcement was nigh on impossible. It is, however, a credit to those involved that the tiger was reasonably controlled and could only bite occasionally. As with all tigers, the keeper exercised a finely tuned mixture of threat, reward and psychology using limited resources.

In this era, an assistant Health and Safety Manager was based at Strathleven, but the post was made redundant in November 1992 as part of an across the board percentage staff cut imposed by Grand Metropolitan - the post being seen as superfluous to the mainstream of the Personnel function. This redundancy increased the workload but in a way facilitated the changes that were required to move health and safety forward.

At the time that the companies merged in 1989, the Executive had recognised that there were gaps in health and safety resource and that the existing resources might not have the skill to take the company forward. A general skills review was carried out and, concerned about deficiencies, the Executive Management decided that to raise the profile of health and safety external recruitment into a higher profile role was required. By mid 1992, however, action had only just been taken to recruit such an individual.

In the period when interviews were finally taking place for the new post, a fatal accident occurred at Blythswood, immediately followed by 2 other serious accidents within one week. The Operations Director of IDV, himself previously Managing Director at Strathleven, insisted upon an investigation of the safety control systems and this confirmed that additional resource and organisational changes were required. The new Health and Safety Manager was recruited externally from the Health and Safety Executive in May 1993 specifically to provide a modern vision and strategic leadership on health and safety. This recruitment, however, effectively demoted the previous manager to an assistant!

Immediately there was conflict between the old guard and the new regime. The new Health and Safety Manager, had been brought in with the same job title, but in a more senior position. Leaving this slight aside there was also a clear conflict between the two styles of management.

The existing style had been to tell rather than show; to be hands-on and police site safety in keeping with the requirements of the old Factories Acts. This was consistent with an older style of safety management (and Personnel Management) when legislation of that period had been prescriptive. By contrast, the new style focused on guidance, support, a hands-off approach and strategic leadership.

Both conflicts were pragmatically resolved by renaming the new employee the Risk Control Manager, while his predecessor kept his title. Responsibilities were split with the Risk Control Manager having a more strategic group role, and the Health and Safety Manager focusing on day to day issues at Strathleven and Blythswood.

In this period J&B also commissioned a joint team from Strathclyde University and Imperial College to investigate any major defects in safety control systems, and to suggest actions for improvement. This work took place in late 1992 and early 1993. The main conclusions and recommendations of this joint Universities' report, published in draft in June 1993, were,

i) Safety management required a strategic lead and the Executive team should set safety policy and commit to it.

ii) The management of safety should be fully integrated with all other management systems, and, in particular, operations should take responsibility for their own safety

iii) The Health and Safety function should be advisory and should focus on specialist support and planning.

iv) The Health and Safety function should report to the Quality and Blends Director rather than the Personnel Director.

v) Additional resources should be brought in to manage health and safety

The report was overly complex and discursive in draft form and was finally issued in a more concise style in March 1994. The company, however, adopted the principles behind most recommendations and began implementing many of them immediately.

1.5.2 SAFETY MANAGEMENT AT PROJECT START - 1993

The performance of the research study reported here within J&B Scotland was one outcome of the Strathclyde report. It allowed additional, cost-effective specialist

resource to be brought into the company to develop and implement strategic ideas and was organised within the Teaching Company Scheme.

At the project outset there was a Group Risk Manager and a Health and Safety Manager (Strathleven & Blythswood) to cover health and safety on all 7 sites. The Risk Control Function as it had been renamed, now reported to the Quality and Blends Director. The Universities' report had suggested this because,

i) There were more synergies between Health and Safety and a modern approach to Quality Management than with Personnel Management even though this was continuing to move towards a more "human resource" dimension.

ii) It had the desired effect of bringing Health and Safety close to production.

iii) In J & B, the Quality Management systems were relatively mature, and were accredited and audited under ISO and, although there was currently no safety management system, there was some recognition that occupational health and safety was a critical management area.

iv) The Quality function had independence from Operations, and this was essential when functional priorities clashed. It had not been deemed appropriate to place safety management in the Operations Department at that time as the functional director without experience and knowledge could be presented with a conflict of interests.

v) Placing health and safety with the Quality team also created immediate movement in the system based on the momentum acquired in the ISO accreditation drive.

In response to the Universities' Report, a new Health and Safety Advisor had been appointed and trained to NEBOSH Certificate level at the Distilleries, and a part-time Safety Co-ordinator trained at Blythswood. These roles were intended to provide locally accessible advice and co-ordination of health and safety. There were safety committees in place at each of Strathleven, Blythswood, and a joint committee for the four Distilleries fed by four local groups.

Other external consultants also provided specialist advice over the years as and when required. Typically this might be for a noise survey, although there had also been a communications survey in 1992 which produced little observable effect – probably because it simply reported rather than offered guidance or direction.

1.5.3 OVERVIEW OF THE DEVELOPMENT OF SAFETY MANAGEMENT IN THE PROJECT PERIOD (1993-1997)

When the research project started, the strategy of the new Risk Control Manager was a mixture of acceptance of the existing, functional system and a desire to manage health and safety in a systematic manner with implementation and responsibility being taken at a local level. This was significantly different from the previous reactive, involved way of managing safety.

It was fortunate that, in this period, the original Health and Safety Manager chose to stay on with the company to assist in the period of transition despite his personal feelings. In January 1995, however, he announced that he would retire from the company in June creating a further need and opportunity for change on the Strathleven site. Instead of replacing him directly, 5 part-time safety co-ordinators each having Health and Safety responsibility as part of their work function were appointed. The co-ordinators (all middle management level) were allocated a section or zone of the site and had day to day responsibility for co-ordinating health and safety in this area as well as their own Departments.

This exemplified the early stages of the process of transferring health and safety responsibility clearly from the specialist function to the general line managers and their workforce. The safety co-ordinators reported directly to their functional line management on all other issues, creating the first stages of ownership. The co-ordinators were trained to provide them with enough expertise to give their line management specific advice and legislative interpretation where required. The individuals selected for the roles by the Risk Control Manager and Health and Safety Manager were all in line management positions and had skills and commitment that suggested they would be suitable for the roles. The initial co-ordinators selected

were distributed as follows: Operations (2), Back shift (1), Cased Goods (1), Laboratories & Offices (1)

Training was provided for the safety co-ordinators in the period before the Health and Safety Manager's departure, and then further support was provided until they were confident to take on more and more of the responsibility. At the same time, new initiatives were developed both to assess areas of deficiency in safety systems (if not safety behaviour) and to reinforce this through incorporation within the management incentive scheme.

Strategic lead was provided from the central Risk Control function by the Risk Control Manager and the researcher. Each site now had specialist health and safety resource in place to implement strategy, and co-ordinate day to day issues.

In January 1997, two years after the original Health and Safety Manager retired and with the same structure in place the Risk Control Manager left the company and the researcher was promoted to the position of Risk Manager. At this stage the remit of the Risk Department was widened to cover all aspects of Risk Management to reflect her background. In addition to health and safety, the department now also had responsibility for business interruption and recovery, environmental management, crisis management, product safety and liability insurance. This extended and very comprehensive remit was to be managed by one person.

To compound this workload, in July 1997, the Security Manager was offered early retirement. When he left, Security transferred to the Quality function from Personnel and the Risk Manager was given responsibility for Security management for the group, and direct line management responsibility for the Security team. With this transfer, all aspects of risk fell within the remit of one functional director of the business - Quality - and all but Product Quality was the responsibility of the Risk Manager. On the bright side, this allowed all aspects of risk management, including health and safety to be fully integrated.

Early in 1998, the author completed her studies. By this time, there had been another change of shift patterns at Strathleven, and as a result an additional safety co-ordinator was appointed at Strathleven. At the end of 1997, a graduate in Risk Management was recruited to provide additional support to the Risk Manager and to the site Safety Co-ordinators. At the other sites, a Safety Advisor was still in place at the Distilleries, and although there had been a personnel change in Safety Advisor for the Blythswood and Bonhill sites, this individual was also trained to the necessary level. As before, the central Risk Management function provides strategic lead and support to all seven sites on all aspects of risk management.

1.6 MANAGING SAFETY IN A FLUX

The extent of change within the Risk function of J&B Scotland, described above, was typical for all functional areas within the business. During the study period there were many further changes, some planned, but many others as a result of numerous organisational and personnel changes. This constant flux of change – particularly at senior management level –is a distinctive feature of the study and would appear to be typical of much of the industry in the period. The company constantly evolved, it restructured and key personnel and policies changed. Against that backdrop, the researcher aimed to design an effective safety management system that incorporated positive performance measures to aid continuous improvement. This system had to be flexible so that it evolved as the company changed, but also had to maintain consistency in standards and commitment.

The process of planning and managing change within companies has been studied and there exist plenty of more or less theoretical commentaries and a few analyses of case histories. Typically a case study might consider the introduction of new technology and would consider the stages of identifying need, planning the change, implementing the process of change and auditing/modifying as required.

There proved to be little of immediate value from a review of the literature of management change. When the project started no company in the UK had

implemented such an integrated safety management system (HSE,1994) and the project differed fundamentally from many of the change processes that were reported. Clearly there was a need to develop a strategic plan that defined and integrated all the components of the final system. Clearly also, the process of introducing an all pervading safety management system would require both involvement of the staff in defining ways and means of doing things safely and the conversion of so-called opinion leaders who could be persuaded to lead the changes. Both of these are presented in literature as key components of change management, but already formed part of the implicit structure of changing safety performance because of the *human* nature of the problem. It was also clear that the work had to be in-house. It would be impossible to develop a system that impacted correctly and continuously throughout the organisation if it were imposed by an external agent. These lessons had already been learned in the development of the quality systems. Perhaps the only *flavour* that was added to the planned recipe was the alternation of theoretical training with practical learning to ensure transmission of knowledge and skills, but that, too was implicit in the involvement of the staff in the change. Ultimately, therefore, little of real value was learned from the review.

1.7 SUMMARY

This thesis records research in action:

i) In an industrial framework characterised by change. Change in organisation, change in senior staff and their methods, in short and long term strategic plans and in the resources prioritised to the Occupational Health and Safety function.

ii) In an organisation (IDV) dominated by marketing needs where the immediate production priorities could change on a daily basis.

In these *interesting* times management of health and safety was developed and successfully integrated into the operational management of the Company. A

success story with the bitter sweet ending of dissolution that closes the story well but loses the effort !

1.8 STRUCTURE OF THESIS

This thesis is essentially split into 3 parts and a conclusion. The first part considers safety management systems and their implementation within J&B Scotland. It is important to note that this work pre-dated publication of the new British Standard BS8800.

The second part considers a number of safety performance measures and assesses the utility of different techniques. Utility, in the real world, is unity for Operational Management and Production Managers – and this is the test applied to each technique.

The third part considers people and their participation in the development and enforcement of safety management systems. It discusses methods by which to involve and engage employees in a safety management program.

Finally, the J&B Scotland system is summarised and both positive aspects and deficiencies are discussed. A brief plan is outlined that could be used at the start of a new safety management program. This plan outlines the key aspects to implement and discusses why each of these aspects is critical to safety management. Clearly, much would depend on the state of the company's existing systems and a pick and mix philosophy might seem possible. It is axiomatic, however, that the system is developed as a whole and it would be unwise to pin together disparate items to form the final system - even though, practically, that would be necessary in the early stages.

2 SAFETY MANAGEMENT SYSTEMS

2.1 SAFETY MANAGEMENT AND ITS RELATIONSHIP TO QUALITY MANAGEMENT

2.1.1 INTRODUCTION

Central to the process of change that was planned for J&B was the relationship with quality management. Driven by the need to bring safety close to production, but thwarted by the practicalities of deficient safety knowledge and awareness in the operations management, quality was an apparently natural home. The relationship was also justified on the grounds that it gave safety an executive level *champion* (the Quality Director) with an enthusiasm for change and experience in implementation and it was hoped that safety could ride *piggy back* on the quality structures and gain from the momentum of the quality process. How useful was this relationship?

Those who are committed to Total Quality Management (TQM) believe that Safety Management is encompassed within their philosophy, along with all other types of management. Although there are indeed significant overlaps and synergies between safety and quality management, there are also critical differences. In fact, there may be considerable conflict between the needs of safety management and those of quality management.

It has been argued that the common management process of implementing, recording, monitoring and controlling of processes is shared by safety management and TQM, and therefore safety is fully encompassed by the TQM philosophy. At a practical level, however, specific references to safety management are rarely made within literature designed for practitioners of quality management. If safety were *implicit* within practical TQM, then it would be expected to appear in such texts.

For example, quality is defined by different authors :

- 'Conformance to agreed customer requirements' (Crosby)
- 'Fitness for purpose or use' (Juran)

- 'Totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs' BS 4778 (1987)
- 'Total composite product and service characteristics of marketing, engineering, manufacture, and maintenance through which the product and service in use will meet the expectation by the customer' (Feigenbaum)

In none of these is safety mentioned. Only in the last definition by Feigenbaum could safety be implied within the engineering and manufacture terms. Even here, however, the last clause emphasises the customer's view and it is unlikely that a customer for a *hard* product will place much importance on a supplier's internal safety performance except as it impacts on delivery time. Where a service is offered there might be more emphasis on safe provision – for example a building contractor's performance might be checked, but that is not explicit in these classical definitions of quality.

One argument why this is so is that there is strong pressure to limit the scope of quality management systems so that the chances of non-compliance and, hence, of incurring the penalty of losing accreditation are reduced. If Safety Management were seen as an essential component in the achievement of TQM, it would be a mandatory part of the accreditation of a quality system whereas, in practical quality management, extraneous or difficult areas may in fact be ignored. Safety management appears to fall into one or other of these areas, and is therefore excluded.

2.1.2 CONFLICT BETWEEN SAFETY AND QUALITY MANAGEMENT

Practical Total Quality Management is essentially about the product and the management of production. As would be expected in a production environment, all systems are focused on the needs of the customer in respect of the provision of a quality product. As a contrast to this, safety management relates instead to the process of operation and the safety of people working within the production process. Often there may actually be conflict between the needs of production and the safety of the work force.

This argument can be framed in terms of the level of acceptable *failure* of the production or safety process and the costs of those failures to the company. It revolves around the impetus that drives product quality and safety, the ability to control both outputs and the question whether they have equal access to funds in a commercial environment – the true conflict.

2.1.2.1 Levels of acceptable failure

An organisation can aim for total quality, but not at total safety. It is possible that in a total quality environment, a situation can be achieved where there are zero defects in terms of the product specification. This is possible because improvements in the quality of a product are driven by the requirements and resources of the customer, and therefore it is possible to improve processes so that these needs are met.

It is, on the other hand, unrealistic to aim for zero accidents in any environment. It is most unlikely that any individual will 'intend' to have an accident, but in any situation where people are present, there will be mistakes - 'to err is human'. In any event it is clear that many accidents have little relationship to human error in the simple sense (Section 4.2)

The automation of a plant may, for example, reduce the number of accidents that occur as there are fewer people involved in the production process – replaced by machinery and with equipment. This will not however, eliminate all accidents, it will instead alter the nature of the accidents - a higher proportion will now be related to repair, maintenance and change-over, and will shift away from production and operational activities (Parry, 1994).

The effect on quality however of automating a plant is that, with enough capital investment, quality errors can realistically be reduced to zero, although it may not be economically viable to do so. At the same time, it has to be recognised that as humans are also responsible for the design and operation of automated plant this may limit the ability of the plant to produce at zero defects. The difference is, however, clear and becomes clearer when profit and loss are considered.

Satisfying customers' requirements will directly increase the profitability of the company. Safety on the other hand is driven by the needs of the employees and by statutory legislation and to some extent by the sense of moral obligation of the company to these employees. Minimum standards of safety are legal requirements, and therefore mandatory. Above this minimum requirement, it is the choice of the company and here there is some equivalence with quality, because quality standards are not mandatory requirements although consideration of safety issues such as flammability of toys are required to protect the consumer. Companies will aim for different shares of the market - low quality, medium or premium quality – and consistent production of a product to cost and to the quality and specifications required by the customer are probably the most important aspects of quality management. The company will also have to ensure the safety of the product insofar as they wish to have a 'due diligence' defence against any claims, and this too will be provided with resources, not because it brings a return on investment, but because it minimises loss. This is exactly the case with safety – often called loss prevention.

It has to be recognised that as expenditure on safety increases, the standard will improve until a point where any further expenditure will only bring a marginal improvement or no significant improvement at all. Expenditure on quality will also eventually bring only a marginal improvement after a certain point, but it may be possible to eliminate all machinery related defects by increasing investment. The 80/20 rule applies to both, but for products the option exists to change the item – humanity may be cloned, but not yet altered!

2.1.2.2 Ability to measure

Typically with a product, goals or criteria are set and performance is measured against them. These goals are set depending upon the ultimate function of the product and the requirements of the customer : reliability, meeting of all specifications, minimisation of rejects internally or externally. For physical products, it will be possible to set and measure whatever level of quality is selected. In the service industry, this is rather more difficult as critical areas are transactions with people - for example, speed of

service, appearance of staff, speed of treatment of complaint and response time. Total Quality Management has some difficulty in addressing this, as staff attitudes and customer perceptions become the independent and dependent variables. One example may be that in a bank, one customer may perceive a waiting time of more than 2 minutes unacceptable, where another will find it satisfactory if the waiting time does not exceed 10 minutes. These differences in attitude will also exist among the employees who are responsible for providing the service. Typically the answer is to set measures that are related to quality, but are physical. This may be the number of times a table is cleaned, an audit of the use of standard phrases, a smile count or the amount of time to serve a customer.

In the service industry, companies are trying to address the perception of individual customers, and the behaviour of individual employees. There is commonality here with safety management where failures are not easily observable, require subjective judgement and close observation. The basis of quality management, however, is the setting of targets and observations of results and, by definition, product quality is observable. Where goals are defined in physical terms, the techniques of quality management are appropriate and it is fortunate for the Service industries that the major 'perceptions' of quality of service – speed, cheerfulness, respect and remedying of mistakes – are well documented and understood.

In safety, where not all failures are observable, there are three main techniques used to measure industrial safety performance.

i) *Monitoring* is generally a post facto measure of incidents and events

ii) *Audit/rating systems* assess factors that are claimed to be indicators of safe working systems

iii) *Concentrated behaviour observation* over short time scales seeks to count unsafe or non-standard actions and, hence, to predict future behaviour

The three methods each have strengths and weaknesses, which often are not appreciated or perhaps fully understood. The methods are complementary and will all have a place within a comprehensive safety management system.

Monitoring either provides statistically unstable or excessive amounts of information. In any event, although 'raw' statistical measures are useful for cross company or industry bench marking, they are not at all useful for line managers at task level because of the time required for stability. Attempts to make statistics more stable by introducing incidents as well as accidents has been shown to introduce bias and requires very significant resources that are unlikely to be available. Often it is very difficult to determine the link between cause and effect, that is, cause of error and incident or accident. In terms of human processes, errors are made for a number of reasons - lack of understanding, training, capability, education, intelligence, concentration- and the specific cause of an accident will be very difficult to identify and even harder to eliminate. By contrast, the cause and effect of quality failures will be readily identifiable and measurable and the corrective action easier to implement. The corrective action for quality will relate to materials, equipment, machinery or some other tangible source rather than lack of concentration, lack of co-ordination, laziness or poor understanding.

Rating systems (linked to audits) on the other hand require the belief that factors that are measured and controlled have a direct, positive impact on safety, and while some factors seem intuitively to affect safety, others have no direct impact and, at worst, the factors themselves become goals or checklists without impact. Rating systems seek to bring about safety improvements and record, measure and control them, and they may fail if the measures are not directly linked with safety performance. They do, however, formalise aspects of management and provide a framework for improvement of safety. Here, there is a similarity between safety and quality management. In quality what is measured must also be tangible, and measurable, and the factors measured must have an impact on quality if there is to be any benefit.

Intensive observation of behaviour has a firmer foundation in that unsafe behaviour has clear links with incidents and accidents so it should be possible to determine a distribution function for unsafe acts and extrapolate it to accidents. The amount of resource that this requires and the skill needs of this resource, however, make this method costly.

It is clear then that matters concerned with product quality will be measurable whereas factors affecting safety are rather less tangible and direct. It has been said that 'what gets measured gets done', but it is equally likely that what is observable gets measured. Certain aspects of human behaviour, and especially attitudes, are very difficult to observe. To further complicate issues, individuals may have flawed attitudes to safety or limited awareness of risks, but may not act unsafely, or may have positive attitudes or awareness of risk and act in an unsafe manner due to external pressures. The complexity of human thought and behaviour means that safety improvements cannot be achieved by simply treating people as if they were machines or products that can be adjusted, measured, monitored and readjusted. Humans will not respond rationally by improving their safety performance in a logical and predictable manner, if performance in fact improves at all (Section 4.1)

What is observable gets measured

What is measured gets done

2.1.2.3 Ability to control

Statistical Process Control (SPC) is used to improve the quality of products and the efficiency of a production process. In SPC, upper and lower limits are set, based, say, on the volume of spirit in a bottle, and all products that fall within these limits are passed or acceptable. Outwith these limits, the product may be rejected – certainly the process will be investigated. Obviously there are a number of attributes that can be measured in this manner such as weight of a product, dimensions, timing, number produced and orders met. It is apparent then, that SPC can be comfortably used when it monitors a process that can be measured objectively, but it does not fit so comfortably with a function requiring subjectivity. It is even the case that although SPC can be used to control a production process and all tangible aspects of it, there

are difficulties with certain quality aspects, such as the 'straightness' of a label, the amount of adhesive used or the legibility of print. The judgement of people is used to pass or reject in these cases using subjective criteria based on experience, training and psyche because automated systems lack cost effectiveness at present.

It is obviously very difficult to apply SPC to human performance and behaviour. For a start, not all human errors will result in accidents or affect a product and therefore may be difficult to identify and assess. The only errors in performance that will be captured will be those with high visibility - such as injury accidents and property damage – and these are output failures rather than signs that limits have been exceeded. When a measurable product attribute goes outwith the tolerated upper or lower limits, adjustments are made to bring the process back into control. This can be accomplished by the adjustment or replacement of machinery and, while there may be some items scrapped, the output as a whole does not contain failures The obvious difficulty is that of not only measuring human performance continuously, but also identifying when it is about to go outwith control limits, and adjusting it when it does. Errors in thought processes cannot be measured, so safety related issues will only be captured when they have resulted in unsafe action, and perhaps an accident.

A first problem then is of insensitive control limits. The second is of limited feed-back ability. If, by whatever means, a deviation in safety behaviour is noted before a failure occurs, how can corrective measures be defined and taken? This requires some understanding of human behaviour (Section 4.1)

2.1.2.4 Visibility, costs and insurance

Safety management has an impact on processes within a company, or 'internal processes'. Failures in safety have an impact internally, and this may result in delays to production or other processes, but these delays and failures will not be visible to the external customer. In certain circumstances, where a company is prosecuted and receives media attention, this will be visible externally as well. Quality failures however, will be visible both internally and externally. A sub-standard product will be visible within the process (and perhaps rejected), but if it reaches the customer, it will

also be visible external to the company. Therefore, failures of safety have direct internal impact and indirect external impact, whereas quality failures have visibility and direct impact both internally and externally.

One of the reasons that priority is placed upon the management of quality is the potential impact of poor quality on the customer, customer relations, profitability and also on public image. Also, and for obvious reasons, as a production company, the production and delivery of a quality product is paramount. Resources, therefore, will be used to ensure that what is seen in the external marketplace is to the correct specifications.

It is very seldom that safety failures affect the marketing or sales ability of the organisation. At the limit, there may be some market reluctance arising from a catastrophic failure in safety – for example with Exxon Valdez, Union Carbide at Bhopal and others - but it is only very severe events or a series of major failings that will influence the market and corporate reputation. By contrast, a failure of quality or alleged contamination has had severe impact on individual products and on the companies that produce them, for example Perrier Water, Johnson & Johnson, and Dow Corning. Safety management on the other hand may only avoid financial loss rather than generate additional return on investment, but it does save lives and reduce human suffering. An additional problem here is that much of human cost cannot be (or is not) quantified. Whereas the loss of a plant or of stocks can naturally be covered under a risk management programme, many of the effects of the injury or death of an individual will not.

There is also a commonly held perception that failures in safety can be and are insured against, but failures in quality cannot be covered, thus increasing the requirement to get it 'right first time'. To address the issue of insurance first of all let us consider an event that crosses the product quality cut-off – a reject – and the safety cut-off – an accident/injury.

Employer's liability insurance will cover losses associated with injury accidents (injuries, claims); and property insurance will cover all aspects of property damage (buildings, vehicles, equipment). Quality failures within production are not, on the other hand, insurable and the company retains all the costs of frozen stock and rework. In product liability insurance, the cover will often exclude product recall costs. These internalised losses due to failures in quality will appear to the shareholder as a reduction in profit, or increased overheads.

The attitude to and management of safety and quality failures, may relate in part to this perception that safety failures can be recovered externally and quality failures cannot. Less emphasis may be placed upon safety, firstly because the penalty for deteriorating performance, in terms of increased premium, will come later in time and secondly, because this penalty may not be significant - premiums are based on an industry or group average performance. It may, thus, be difficult to gain advantage by a reduction in premiums for an improved performance due to the effect of averages and, for a less than average company, it is effective to 'insure' against safety losses.

Set against this perception is the fact that insurance cover does not and will not cover all aspects of safety losses. The vast majority may be left unclaimed and therefore are a drain upon a company. Research of losses at J&B and by other studies suggest that at least 80% of loss is uninsured (Heinrich 1959; Bird 1976; HSE 1993a; HSE 1997). In Employers Liability, the following costs are not insured or insurable : fines; lost time; investigation time; lost production time; replacement labour costs; fixed costs; training and re-skilling costs. Therefore, every time there is an injury accident, the majority of the costs are retained by the company, often without its knowledge. On the property side, there may be an excess on the policy and in J&B this is £25,000. That is, the company will have to pay the first £25,000 of each and every damage incident cost, and the insurer will cover the risk above this limit. The annual Employer's Liability premium was £70,462. Analysis by the researcher in J&B of the dispersion of claims and losses shows that the majority of losses fall below this threshold which means that the company is retaining the risk and costs of a significant proportion of damage losses.

2.1.2.5 Funding bias

A crucial part of the conflict between safety and production, is that improved quality has the ability to increase profitability and ensure the continued existence of the company, whereas improved safety will only limit losses. Brehmer has discussed safety management at senior levels within companies (Brehmer, 1993). Citing *Prospect Theory*, he suggests there will be intrinsic bias against safety and towards production/ quality goals because,

i) Loss is emphasised over gain.

ii) The more immediate the loss, the greater the emphasis.

iii) Certainty is preferentially selected over uncertainty.

The theory suggests that, when presented with a choice of loss or gain with limited resource, losses are focused upon and if that loss is one that will be suffered immediately, or in the near future, it is seen as even more important or critical than one that will occur in the distant future. Prospect theory also proposes that when presented with the choice of certainty over uncertainty, people are inclined to select certainty. Considering the effect on safety, it is suggested that expenditure on safety management will be seen as an immediate loss compared to investment on production, and that safety gains are not only uncertain, but in the future. Safety gains are, in real terms, losses that have been avoided or limited, and are therefore both deferred and exponentially limited.

In most instances in industry, there is intense competition for funding between organisational functions and the disadvantages to production of increased spending on safety will almost always be more firmly and immediately quantified, than the long terms benefits that *may* be gained. The uncertainty of any improvement in safety and any return in financial terms, where there has been an increased investment, causes difficulty in the justification of such an investment. As discussed, where production can increase profitability of an organisation, safety can only limit loss and the term *loss control* is often used because enhanced safety can only provide savings that approach a limit defined by loss due to unsafe actions. Naturally, companies will tend

to focus upon the improvement of the product or service and will tend to consider safety management as an onerous legal requirement that removes resources from this effort. It must be emphasised that this is not to suggest some sort of criminality: an organisation exists to produce, but it does mean that the incentive to manage safety will be different from that of quality within an organisation.

Given that Total Quality Management will usually be based within the production function or similar whereas safety can be found in various places within the organisational structure (often Personnel), it will be seen that there is an underlying bias against expenditure on safety. This bias will not be corrected by the simple incorporation of safety within TQM; it has to be explicitly addressed and fully incorporated at a functional and operational level.

2.1.3 COHESION OR SIMILARITIES BETWEEN SAFETY AND QUALITY MANAGEMENT

For all that has been said on the considerable differences and conflicts between safety management and quality management, there is also a great deal of cohesion. It has been suggested by the Health and Safety Executive that companies should use the models for quality management upon which to develop a structured safety management system and this is good advice. A systematic approach to safety management as taken with quality management can have many benefits in terms of consistency of approach, avoidance of the duplication of resources, and prevention of gaps in treatment of safety issues. That last point is of particular importance as it is for any situations where there is reliance on the vagaries of *human* behaviour.

Here, then, the arguments can be framed in terms of

i) the benefits of a unified, systems approach,

ii) the synergy that should exist between all forms of *good* management that increases profits,

iii) the very substantial similarities in administrative techniques employed and the enthusiasm that can be generated to do a better job.

A systems based approach implies consistency of approach to many of the problems within management and TQM should, if an honest system, encompass safety management within its remit. In common, therefore, with other management systems there should be mechanisms to set and react to targets and respond to non conformances. There should be cost savings arising from integration of training and from the same areas that TQM claims to target - lost time, lost production etc.. Finally, the drive for continuous improvement that is central to TQM is also very appropriate for safety management.

In J&B it was recognised that these were the main benefits to be gained from the location of the *risk* function within the Quality Group. Thoughts of applying the *hard* numeric techniques of SPC would take second place to developing the administrative framework of policies and procedures and populating it with ways of working that would be developed by those who both produced and bore the risk – the operational workforce.

2.1.4 DEVELOPING A PROACTIVE SAFETY MANAGEMENT SYSTEM IN J&B

2.1.4.1 Need

The approach to health and safety within J&B Scotland prior to 1994 was very traditional, more reactive than proactive and based more on the performance of machines than of humans. There was little documentation or consistency in the management of health and safety across sites or departments, and problems were dealt with as they arose, rather than in advance through strategic planning. The traditional role of the safety specialist was that of a policeman for when things had already gone wrong, rather than as a planner and advisor on continuous improvement.

Chronological Order of Events	
1977	Health and Safety Manager appointed in an enforcement role.
1987	Strathleven Bonded Warehouses taken over by IDV
1992	Risk Control Manager appointed into strategic role.
1993	Initial study by Strathclyde University
1994-1997	Study period – development of safety management system and case studies.

An initial status review in the form of an audit (using CHASE), an attitude survey and a review of safety across the company revealed that a formal, structured safety management system would be beneficial in many ways. The audit aimed to evaluate the current position of safety, and to determine what improvements were required to advance the standard of health and safety in the short, medium and long term. It was determined that a structured system would help to avoid gaps in safety coverage, either between departments or between sites, and prevent the duplication of resources allocated to safety management in terms of time or finance. A consistent approach to safety across the company would ensure that standards and systems were uniform. In fact, a system covering all sites was intended to encourage closer working relationships between the safety personnel at each site, including the sharing of 'best practice' and resources. This was a very important aspect - safety is allocated fairly limited resources as it is not generally viewed as a contributor to the profitability of the organisation. Even in proactive organisations, safety has a difficult task in convincing management that it is worthwhile investing in the minimisation of loss, when resources can alternatively be invested in production and a more certain return on investment.

Without a formal system to deal with safety within the company, when safety personnel changed the treatment of safety changed, losing consistency of approach and reporting. When personnel left the company their expert knowledge was lost. A written system was intended to provide continuity and transfer of information without being rigid and inflexible, the system acting as a reference book for company safety policies, standards and procedures to follow. This clear communication of the company's treatment of safety was intended to be available to all personnel, as it had never been previously. Inconsistency had led to disagreements between employees under different managers, in different departments and across sites as some were operating at basic minimum legal compliance, and some at higher standards.

Another perspective was that executives could now be prosecuted as individuals for 'corporate manslaughter' due to their criminal negligence of Health and Safety duties. Managers can be made personally liable for any failures in these obligations, without

having to *physically* carry out an unsafe act. Although the majority of executives charged with 'corporate manslaughter' receive suspended sentences and substantial fines from *personal assets*, a Managing Director in the UK was recently sentenced to three years imprisonment following the trends in the USA (OLL, 1994). It is likely that this is a precedent that will be followed. An effective Safety Management System can provide evidence that the senior management and executive within J&B are committed to and active in health and safety. It is also the case that effective management of safety will enable the prevention of a serious accident, or in the event of such an accident occurring a visible, proactive attempt to manage as safely as possible can protect the corporate image from damage.

From a defensibility perspective, the prior regime had very little documentation and therefore little evidence in event of a court case. An effective safety management system can be used towards a defence in court in event of an unforeseen liability or negligence claim. Clear record keeping procedures and systems act as proof of compliance to legislation and codes of practice. They are, however, hostages to fortune if not usable and used.

The design, development and implementation of the safety management system would raise the profile of safety in the eyes of the work force and increase the feeling of ownership of safety within the company. It would, therefore, be a safety initiative in itself.

It was intended that all personnel on site would take responsibility for their actions and decisions in relation to safety using the concept of 'safety on the line by the line'. This would be achieved by incorporation of safety units and safe systems into the training of all new personnel and into the refresher training of existing personnel. This training would be fully documented enabling it to be updated regularly. The active involvement of employees and management from the developmental stage of the system onwards would also increase understanding and commitment to safety.

2.1.4.2 Opportunity

A good opportunity to design and implement a new safety management system existed when the Risk Control Department was undergoing redesign. It could be relatively cost-effective as the resources for developing the system already existed within J&B. When the company originally achieved accreditation to the quality standard ISO 9002 in 1992, safety was not specifically included in the system, and often the contents of the quality system contravened legal requirements and or good safety practice. In fact, arguably it had been excluded as it was not managed consistently and systematically and therefore may have jeopardised the achievement of the ISO accreditation. It is often the case that companies will leave out apparently difficult or peripheral areas such as safety from quality management systems. Strangely, however, it is safety and not quality management that has legal requirements to fulfil.

2.1.4.3 Integration

It was intended to design a complete safety management system for integration into the ISO system as a stage towards achieving a total management system. Around one year into the development of the safety system, there was another progression - the J&B business management system. This system combined and integrated all of the other management specialisms that were not included in the original ISO system and health and safety management was now recognised as sufficiently coherent for incorporation.

2.1.5 FORMALISED SAFETY MANAGEMENT SYSTEMS

2.1.5.1 Introduction

Studies undertaken by the Health and Safety Executive, and other organisations, during the 1980's identified that up to 80% of all accidents could have been avoided by taking reasonably practical precautions. These studies also found that in nearly 70% of all cases positive management action could have prevented injury to employees (HSE,1993).

Accidents fall into essentially two categories,

- "hardware" failures such as deficient plant design, physical safety control system failure, non-suitability of equipment and tools.
- "software" failures such as inadequate training, deficient systems of work and procedures, inadequate instruction and supervision, lack of knowledge.

Early health and safety legislation was focused almost entirely on the hardware or physical control systems required to deal with specific risks. This legislation was *prescriptive*; specifying the requirements in terms of machinery and equipment controls and standards rather than concentrating on humans in the workplace. As proactive companies met their physical control requirements, they recognised that accidents still existed in the workplace, albeit that the main type of accidents had shifted over time. Instead of crush, fracture and amputation injuries - the main type of accidents had moved towards slips, trips and falls, back injuries and stress related illness.

Since the introduction of the Health and Safety at Work Act in 1974, corporate attention has gradually been diverted away from purely hardware failures and control systems and moved towards the impact of software failures. This trend has been seen at J&B Scotland where high standards of hardware control were implemented in the 1970's and 1980's including machinery guarding and other physical control mechanisms to separate the employee from machinery. Physical control measures have helped to prevent certain types of accidents, especially those caused by contact with moving machinery, but inconsistencies in standards of training and lack of procedures have contributed to the accidents that have continued to occur.

The HSE have also demonstrated that there is a positive correlation between organisations that demonstrate high standards of general business management and high standards of Health and Safety management (HSE, 1993). This is achieved through self-regulation of legal requirements as well as the creation and maintenance

of specific tailor-made standards and controls commensurate with the risks inherent in their business.

To achieve the high standards required, Health and Safety must be treated in the same way as all other corporate goals. Potential conflicts of interest do exist between production or quality management and safety management, but a fully developed, formal Safety Management System, taking into account the specific issues that separate it from other management systems, would, help to achieve high standards and it was clear that a complete safety management system incorporating all aspects of proactive safety management should be developed.

Certain aspects require particular attention in such a system: specific legal requirements; measurement and improvement systems; human behaviour; and employee knowledge (safety training). The most critical aspects are to do with people.

Coincidentally, around nine months after the project was initiated - in December 1994 - a draft British Standard BS 8800 " The Introduction of a Safety Management System"(BSI, 1996), was released for comment. This standard was re-drafted and finally released formally as BS 8800 " A Guide to Safety Management Systems" in May 1996.

2.1.5.2 The safety guidance model

BS 8800: Occupational Health and Safety Management

BS 8800 had been developed using as guidance the models taken from the Quality Management Standard ISO 9002 and a Health and Safety Executive document, HS (G) 65 'Successful health and safety management'. In addition, BS 8800 is similar in overall philosophy and structure to the environmental management and quality standard BS 7750.

This project was launched ahead of the inception of BS8800 and work was already underway as BS8800 was being developed. The J&B safety management system and

its complementary tools were already partially completed when the standard was finally released. A decision was made, and confirmed at executive level, that J&B would aim for early accreditation to this standard, and to facilitate integration the work performed under the project to date was compared with BS 8750, with revision where appropriate. No significant changes were, however, required.

British Standard BS 8800 provides guidance on occupational health and safety management systems (OHS) to assist in compliance with stated OHS policies and objectives, and on how OHS should be implemented in an organisation's overall management system. The Standard takes the form of guidance and recommendations rather than prescriptive specifications.

There has been some debate over the introduction of a health and safety *standard*. Critics raise the concern that companies who have been accredited against BS8800 may become complacent in attitude to health and safety, believing that compliance with that standard relieves them of any further responsibility, in particular, for *continuous improvement* of safety standards – a worry that is common among safety (and quality) practitioners. Experience shows that companies, in fact, are correct in believing that a protection against HSE prosecution, if not a defence in a civil court, could rest on having an accepted system for health and safety - a view that could be taken as in part releasing them from further duties of care. Advocates of the system, on the other hand, suggest that by working towards certification and maintenance of this accreditation, at the least the company will be aware of all of its statutory obligations, and will implement and maintain a comprehensive system for the continuous improvement of standards of health and safety above and beyond those required by law. Few specialists, however, doubt the need for a formalised safety system.

As in quality management systems, it is possible to achieve accreditation and maintain it as long as standards as consistent

Unlike quality management, the baseline of safety management is set by law. It is not possible to achieve and maintain accreditation without meeting *at least* minimum legal compliance

- even if standards are consistently low. However, unlike quality management, law governs the baseline standard for safety management. Therefore, it would not be possible to achieve and maintain accreditation without meeting *at least* minimum legal compliance.

From a safety perspective, it is perhaps true that some companies may use their accreditation as a method of achieving and maintaining minimum legal compliance alone. It is already true, unfortunately, that many companies do not even meet this minimum standard at present. At the very least, therefore, certification and a full occupational safety and health management system would ensure that minimum legal standards are met and make companies aware of their obligations. Proactive companies however, will have a powerful catalyst to facilitate continuous improvement via a fully structured safety management system. In this environment, the safety system could be fully integrated into the other key business management systems, rather than standing alone.

A comprehensive system for managing occupational health and safety must incorporate all relevant activities: setting of policy, promulgation of standards, risk assessments, training, auditing, communication and review. BS 8800, the guidance to occupational health and safety systems, has provisions to cover all of these components.

Just as ISO 9002 aims to create a competitive advantage for the company in terms of cost-effective product quality, BS 8800 can also create an advantage. The safety management system will lay out formal procedures for dealing with health and safety, and provide a fully integrated, consistent system reducing waste due to duplication and confusion. Effective safety management will reduce the cost of production increased by safety failures, and it can provide a positive contribution to the efficiency of operations in line with other functional areas. The following table summarises the advantages and disadvantages (in no particular order) of a formal safety management system.

TABLE 1

BENEFITS	PROBLEMS
Greater legal compliance	System may not be used
Consistent approach to safety	Extensive paperwork
Clear standards set as goals	Time consuming to implement
Increased employee involvement.	No direct impact on safety outputs
Greater commitment to safety	Hijacking by production unless protected
Potential accreditation to BS 8800	Poorly constructed system may be dangerous
Evidence in court or to avoid prosecution	
Improved communication	
Integration into other management systems	
Safety perceived as equal in importance to other functional areas	

It is one of the many facts of life and safety management that while it is hard to manage safety well without a formal system, the formal system will itself create risk if not well produced, relevant and active.

Following BS8800, therefore, enables rather than produces effective management of all aspects of health and safety. It provides two optional models on which to base an Occupational Health and Safety Management system. One is HSG (65) 'Successful Health and Safety Management', and the other is BS EN ISO 14001, the international environmental management model.

To be effective, BS8800 had to be simple and easy to implement for businesses small and large. It was important that it did not conflict with already existing health and safety guidance published by the Health and Safety Executive and it also had to be complementary to an organisation's existing management systems - perhaps BS5750. The committee developing the guidance standard recognised that, if it was to be successful, the guidance would have to provide benefit to business by reducing risk to

employees, help improve business performance, and allow integration with current management systems. All elements of the system, from the manner and extent of application are, however, dependent on organisation scale and operating activities and the nature of the industry itself dictates the level and type of risks present.

The two models within BS8800 contain the same elements, although there are differences in respect to the order - in particular in initial and periodic review, organising, planning and implementing safety management. At first glance it is clear that the model based on ISO 14001 has many similarities to ISO 9001.

2.1.5.3 A Discussion of the Main Components of BS8800

Initial Status Review

With either approach, a comprehensive study into the current status and position of existing health and safety management within an organisation must be carried out at the outset. This enables a baseline position to be ascertained, against which future standards and status and any progress can be compared. The study will cover the extent to which relevant legislation has been implemented to date, the systems in place, the procedures and standards that already exist in relation to health and safety.

The results of prior audits are a useful tool for an initial status review, they illustrate what health and safety measures have been implemented and the action points that have not yet been introduced indicate what has still to be done. In addition a large scale attitude survey *could* be carried out to enable an evaluation of the current 'safety culture' within the company although (Section 3.3) comments later on the benefits or otherwise of such surveys.

A review of the management of health and safety and organisation of responsibilities should also be conducted. This should be examined in relation to the current resources, and future requirements. Plans have to be made by the system to enable the initial status review to be updated at periodic intervals after implementation of the initial system. The review will consider accident rates, gaps in current coverage, resources and organisational set-up. It will also examine best practice in industry or

sector, standards set by the parent company if any, corporate strategy for occupational health and safety, industry standards. The requirements for an initial status review are the same under either model.

An initial review had been performed at J&B and had proved very useful if not essential. It should be made clear, however, that such a review requires a relatively advanced level of knowledge and this may not exist within a company. The temptation is to employ consultants (as indeed J&B Scotland had done), but this will seldom have the depth required and does not result in knowledge residing in the organisation. Indeed, there have been recent moves by HSE Offshore Safety Division to require Health and Safety knowledge and skills within companies as excessive use of consultants was not proving effective. A first move by any organisation, therefore, must be to employ relevant H&S skills.

Definition of Occupational Health and Safety Policy

Once the initial status review has been performed, the organisation should have a clear understanding of what has currently been achieved, and what deficiencies there are. The policy of the company and the system can then be devised.

If there is an existing environmental or quality management system in place, this would shape the choice between the models proposed by BS8800. The ground rules are laid down in the policy: commitment by senior management to objectives of the company for health and safety; definition of the responsibilities and accountabilities of personnel; and the setting of standards. The policy must be endorsed by the senior management team, and displayed for all employees.

In later sections the question of executive commitment is discussed. Here it is, perhaps, sufficient to note that frequent change at senior management level seems common in larger organisations and, although this may not change the terms of the HSE policy, it will change the emphasis of commitment and, by changing organisational structures can create a state of flux equivalent to a leadership vacuum.

The policy should have nine integral features and these are required by both models. The key features are:

1) compliance to legal standards as a minimum
2) continual cost effective improvement in performance
3) provision of adequate and appropriate resource
4) definition and publishing of OHS objectives
5) placing management of OHS as the prime responsibility of line management from Executive to supervisor
6) ensure understanding and implement and maintain at all levels of the business
7) ensure employee involvement and consultation to gain commitment
8) periodic review of policy, of management system, and audit of compliance with policy
9) train all employees at all levels appropriately so they are competent to carry out duties and responsibilities

<u>Organisation</u>

Although the stipulations are listed under different sections in the two models, the organisational requirements are the same. The company is required to consider responsibilities, organisation and documentation. The standard stresses that documentation is the key to the success and consistency of an OHS system.

Documentation *is* the key in assembling and retaining critical information and for planning, but it is important that it is kept to a minimum to avoid bureaucracy, and must be appropriate for that company, its activities and level of risk. The system should not create the opportunity to swamp the organisation with excessive paperwork and bureaucracy.

At this level we are below the executive and within the body of the organisation. Here too there can be frequent upheavals, but there is a greater inertia to resist change in that things that were done continue to be done. From the J&B experience, this level of organisation is considered critical to success and efforts should be made to optimise the OHS organisational structure in advance of implementing the H&S plan.

Optimisation should be in terms of independence and influence both upwards and across into the organisational functions that produce risk - production, process and maintenance.

Planning

Both models suggested by BS8800 require an organisation to identify its OHS aims and objectives, determine plans to action to achieve these aims, identify who is responsible, the timescales in which action is required, and the outcome to be achieved. The two models contain the same requirements albeit set out in a different manner.

In practice this is possible at first only for development of the *hard* components of the SMS such as procedure documents. That is, a deadline might be set for completion of various levels of these. It is less easy, for example, to be firm about when safety training is to be integrated with induction or task training.

Risk assessments are required to identify hazards and evaluate them in terms of levels of risk, relevant legal and other requirements should be identified and appropriate controls implemented. These have to be performed by those who produce and work with the hazards.

Implementation and Operation

This section focuses on the structure, organisation and responsibilities required of a company for effective occupational health and safety management. It sets out requirements for adequate training, ensuring awareness, competence, effective communications and documentation.

Measuring performance

A section of both models provides focus on measuring performance, the key to providing feedback on the effectiveness of the occupational safety management system. It requires that both quantitative and qualitative measures should be considered. It requires monitoring of the extent to which policy and objectives are

being met by using both proactive and reactive measures, such as site inspections, documentation required to demonstrate legal compliance, checks of Permits and Safe Systems of Work and investigation of accidents, near-misses and historical data. The measures should be chosen by selecting a mixture appropriate to the needs of the organisation.

This project is greatly concerned with the effectiveness of various measures of safety. It is essential, to devise measures of how effectively the SMS is being implemented and managed and these measures must be agreed with those involved.

Periodic Status Review

The standard requires that reviews are performed to consider the overall performance of the OHS system; performance of individual elements; findings of the audits; internal and external factors that may have changed. The factors that may have changed could have been organisational structure or policy, operating activities, legislation or technology. One clear lesson from the J&B experience is that it is essential that the OHS system can adapt to changes whether from an internal or external source over a period of time. The reviews should identify if action is required to remedy deficiencies or cope with changes. The overall performance of the system and influence of internal and external factors should be used to minimise risk, improve the system and improve business performance.

Internal and External Factors

Both models require that both internal and external factors be considered on an ongoing basis. Internal factors have a significant impact on occupational health and safety management within an organisation, and will change over time. Typical factors to be considered include: the level of senior management commitment; size and organisational structure of the organisation; nature of activities, business, and risk; resource and skills; priority within the business; policy and objectives. External factors impacting an organisation or site can include: legislative change; merger or downsizing; development of information, knowledge or technology; changes to other businesses sharing premises; change in political or economic or social environment.

Other typical external changes would be a parent company restructure or merger, change in Global OHS policy or change in industry guidance or work practices. Even significant changes in the economy or political changes can affect and organisation over a period of time, perhaps changing OHS requirements.

Internal changes can be addressed as effectively under a structured safety management system. These factors are constantly changing from small incremental changes to major organisational changes. Typical examples of change affecting all organisations, probably constantly(!), are management structure, financial resource, people resource, change of activities, management attitude and commitment, safety culture, product volume and so on.

Hard Fact 1

There will always be internal and external changes imposed that are designed to destroy your plans, your projects and your sanity

2.1.5.4 Similarities between HS(G) and BS EN ISO 14001, the International Environmental Management Model.

The model that an organisation selects will be partly dependent upon the systems that are already in place. The overall contents of the two models are the same, but the structure of the models is slightly different.

The initial status review is the same regardless of model; both require an organisation to consider all aspects of occupational health and safety. In the Policy section of both models, the organisation is required to determine and make commitments to the effective management of occupational health and safety.

The next stage 'Organising' relates to structure, organisation and responsibilities. Organising is a separate section under HSG (65), but it is integrated into 2 separate sections -Planning and Implementing in ISO14001. The requirements are the same, but they are listed in separate sections. The ISO model differs to help companies already with accredited ISO systems to follow the existing system.

Finally, both models require a periodic status review, it is integrated into the Management Review section of ISO 14001 and a separate section of HSG 'Performance Status Review'.

It is important to remember that the requirements of the 2 models are the same, and the different layouts aim to make it easier for an organisation to integrate into already existing management systems, or provide an option to start from the beginning.

2.1.5.5 Similarities between BS 8800 and EN ISO 9000, the International Quality Management Model

British Standard (BS) EN ISO 9000 is a national standard for quality management systems, first published in 1979. The standard itself is fairly general and provides a number of requirements, which an organisation should follow to ensure the quality of their products or service.

Areas such as management responsibility, corrective actions, planning and purchasing are covered by the standard. It aims to provide a proactive system that will prevent quality errors occurring and provide a system with which to manage corrective actions if an error has occurred. The quality management system then helps control internal processes that aim to satisfy the customers needs, to reduce costs and to improve internal management processes.

The standard is not intended to stifle creativity and innovation by a strict control regime, instead it aims to limit inefficiency and lack of control over processes and systems, providing an environment of continuous improvement. In principle, as processes are controlled and errors eliminated, it should provide for a more economic method of operating throughout the process, to the customer. In a quality system, a fully controlled documented system can help to demonstrate 'due diligence' in relation to a product liability claim.

The guidance standard BS 8800 sticks fairly closely to the layout and contents of ISO 9000. The standard states that if the company already has ISO 9000 or ISO 14000, then that model can be used to form the basis of the safety management system. If an organisation already has accreditation, then a large volume of the workload will be saved. Also, and perhaps more importantly, using a similar model for management systems should enable their integration at a later date. It will also be easier for a work force to use a Safety Management System if it has been written with a familiar structure and layout.

There are critical differences between occupational health and safety and product quality management.

These must be managed if a safety management system is to be successful.

Those who disagree – are wrong!

There are, however, critical differences between occupational health and safety and product quality management, and these must be managed if a safety management system is to be successful.

Primarily, the differences between safety and quality are, firstly that OHS is governed by legal requirements whereas product quality is not; secondly, that safety relates to people and quality to product and thirdly, safety performance cannot be measured with the same techniques as product quality. The potential conflict between these fields, the differences, and the method of overcoming these differences are discussed in detail in another section.

2.2 DEVELOPMENT AND IMPLEMENTATION OF A SAFETY MANAGEMENT SYSTEM AT LOCAL AND INTERNATIONAL LEVEL

2.2.1 INTRODUCTION

The SMS was designed initially to cover all 7 sites within J&B Scotland, with flexibility to address the different management structures and operations at each site.

The system was structured in such a way that, although certain components are constant and consistent, others can be adapted for local factors. It was envisaged that eventually the system might be transferred to non-UK operating units, firstly within then European sites and eventually across the rest of the group. As there is common European safety law and standards, the transfer to the European sites was not expected to require extensive modification other than to the accountabilities and management structure. It was envisaged that more extensive modification would be required for the rest of the world, particularly in relation to cultural differences.

The system, when it had been fully developed and trialed was also intended to act as a model for the drinks division of Grand Metropolitan. This aimed to achieve further consistency firstly in the UK and Europe and eventually worldwide. This approach fitted well with the programme for worldwide implementation of ISO 9000. Also, the companies within the group that already had accreditation with ISO 9000 would have a model for the addition, albeit retrospectively, of a comprehensive safety management system. All operating sites that were to be accredited with ISO in the future would be able to introduce a complete quality system incorporating the requirements of BS 8800 from the outset.

Critically, there would be no point in devoting time and resource to the development and implementation of a system that acted as no more than proof of an attempt to improve safety on site. There was genuine belief that having a full understanding of the companies current status in safety terms would enable clear identification of all legal requirements and safety issues, methods of loss control, communications and training that would facilitate the continuous improvement of safety within the company. To ensure that the system is used, it is required that rational practical procedures, written by the users themselves are developed. Auditing and safety performance measures must be implemented to check that, one: the system is being used, and two: the system is having a positive impact on the standards on site. If there is intelligent development, monitoring and continuous improvement of the system, safety standards should improve, thereby reducing the cost of risk and the cost of non-conformance's within J&B in both the medium and long term.

The reduction of operating cost would, in turn create a cost advantage against competitors. Efficient effective operations can be achieved with safety and loss control having valuable contributions to make. It was determined that a systematic approach to safety would incorporate all hardware and software measures that will help to facilitate continuous improvement.

2.2.2 ORGANISING AND DEVELOPING THE SAFETY MANAGEMENT SYSTEM

2.2.2.1 Organising

Differences in standards across sites

The seven sites within the company had different cultures but the biggest contrast was probably between the packaging site and the Distilleries. There were clear social or cultural differences in terms of work pace and unionisation, but also differences in working operations, responsibilities, tasks and activities. Further, each site had different organisational structures, resources, skills, activities and job descriptions and the smaller sites tended to have flatter, less hierarchical structures with more integration of tasks and job descriptions. As a result of these differences, a single system designed to 'fit all' sites would not be effective for any site and it was important to involve all sites in the development of the safety management system at an early stage, rather than simply imposing a system designed by the 'centre' and risk it being rejected. Importantly, involvement of the safety advisors from the other sites would help to ensure their commitment and bring in diverse ideas.

Standardisation and flexibility

It was agreed that a single, standard company Occupational Health and Safety *policy* (and associated standards) must apply for consistency, but that there should be flexibility in procedures, documentation, reporting structures, communication and safe systems of work to reflect the differences between sites. This approach aimed to ensure that corporate objectives, policies, commitments and standards were consistent and uniform, whilst recognising organisational (structural) and operational (task) differences. All sites had to comply with legal standards, Grand Metropolitan/ IDV standards and J&B Scotland standards, but there was flexibility allowed in the implementation of these standards.

Steering and Working Groups

To ensure the process was managed effectively, a cross-site *Steering group* was set-up. The Steering Group consisted of the researcher as Chair (and Secretary) and the site safety advisors from Blythswood and the Distilleries, with Risk Control Manager and Quality & Blends Director being involved as required. The involvement of key players from each of the sites enabled site input into standards.

At each of the sites, a *Working Party* was set up, typical membership being the site safety representative, a production manager and safety committee members. The site Working Parties ensured that there was commitment and feedback at each site, regular input and communication to and from that site. These teams were involved in all aspects of the development and launch of the safety management system.

Initial Status Review

The initial status review was carried out to determine the status or standing of occupational health and safety within J&B Scotland, before implementation of a different structure. All aspects of OHS were considered including the current organisational structure; human and financial resources; historical accident statistics; previous OHS audit results; safety committee minutes; OHS policies and standards and parent company policies and standards. In addition to a documentary search, structured interviews were carried out with members of the Executive team, management team, safety committee, safety co-ordinators and safety specialists.

As noted in Section 1, a comprehensive initial assessment had been performed by a University team. That had covered many aspects through management interviews, site inspections, and assessment of existing policies and standards. The results of this study were considered alongside the internal and external factors influencing the organisation – that is, the management structure and the customer requirements.

An awareness study was carried out by the researcher, focusing around the COSHH Regulations but also capturing information on general OHS awareness, training preferences and effectiveness of communication on OHS.

The basic initial status review took place over a period of approximately 6 months and covered all sites within the group. The results enabled a benchmark to establish what was already in place, what standards were to be set, what improvements were required, gaps in OHS cover, and the future impact of internal and external factors. A strategy was then developed by the Steering Group to move the company standards forward.

Strategy for developing the OHS Policy Statement

With all the information provided by the Initial Status Review, a strategy was formulated. The Executive team, apart from the Blends and Quality Director, would not be involved in the detail of the policy during its development. For effectiveness, the Steering Group worked on the initial detail, and presented it to the Executive team. The Steering Group first discussed the key elements listed by BS 8800, and integrated them with the corporate strategy into a Policy Statement. The contents and commitments section of the Policy was then drafted by the Executive team members before being re-drafted by the Steering Group and sent back for approval.

The key elements included accountabilities; resources; review and measurement; responsibilities; legal compliance; employee involvement; communication; training; audit of compliance and continuous improvement. The commitments were written into the Policy Statements and signed off by the Executive Team. The Policy Statement was communicated to all employees by display on walls in each area on the sites. It was also issued to all existing employees with wages slips, and issued to new employees with their starter packs.

The process to develop and issue the policy was more onerous and time consuming than had been anticipated. There was lengthy debate at each stage of development - this process was not fluid and was often protracted. Eventually a balance had to be struck to ensure that key players had an input, but avoid change for change sake. That aside, it was relatively easy to get approval for the policy to be issued, but not so simple to get genuine commitment to proactive management of safety. As has always been the difficulty with safety, there will always be other business priorities, some of

which conflict with safety requirements. The issue of a new 'policy' does not have the power to change these priorities, only a change in level and nature of senior management commitment can. To add further difficulty, measurement of commitment (or a lack of commitment) is largely based on perception.

2.2.2.2 Developing the safety management system

Organisation Section

The company had an existing ISO 9001 system; therefore it seemed reasonable to adopt the model based on ISO 14001 for OHS [discussed in detail in Section 2.1]. The *organising* section of the Policy Manual outlined the major roles with regards to OHS within the business, discussing the roles of the Managing Director, Executive Member with ultimate responsibility, Risk Department, Safety Co-ordinators, Safety Committee, Line Managers, and that of all other employees.

For each of these roles the responsibilities and accountabilities were outlined with the focus on the structure, organisation and responsibilities required within the company to ensure effective management of occupational health and safety.

Most importantly, this section allocated appropriate levels of authority and financial resources to ensure that OHS policy could be effective. The commitment was made that where in-house expertise was not adequate, specialist advice would be readily sought from outwith the organisation.

Critical requirements for the organisational structure:-

Authority and financial resources to ensure the policy would be effectively implemented

An organisational chart was constructed showing lines of communication between these key roles and also from Strathleven to and from the other sites.

It was important that, although strategic lead came from Strathleven, this lead was after consultation with and involvement of the other sites and their local teams. These

site teams were to have responsibility for local implementation and the details of communication, training and other matters.

Priorities

After the policy and organisation sections, there followed a series of brief specific policies on the priority commitments made by the company. The Steering Group highlighted key areas of concern from the Initial Status Review either because it was felt that they had been inadequately managed or because of the level of risk, perhaps inherent to the drinks industry or the company. Safety aspects that were specifically mentioned in these policies were - fire prevention and control; task and project control; risk assessment; training and development and employee involvement. For each of the commitments made in the Policy Statement, there was a brief specific policy and each of these specific policies was linked to related company standards, safe systems of work and relevant documentation. These links were listed with the policies for cross-reference.

2.2.2.3 Communication of safety policy

Once the Policy Manual and its commitments were agreed by the Steering Group and the site Working Parties, the Policy was communicated to the Executive Team for agreement and authorisation. The OHS Policy Statement was then posted in locations around the sites, on notice boards, communicated at team briefs, at safety committee meetings and management meetings. A copy of the Policy Statement and arrangements section was posted to all employees with their wages slip. The Group aimed to communicate the OHS priorities to all employees and visitors.

2.2.2.4 Resources review and actions

Groupings

As the Steering Group considered the results of the Initial Status Review, it became clear that the resources allocated for OHS must be reassessed. Prior to the assessment, a member of the Executive Team (Quality and Blends Director) had been given organisational responsibility for OHS, with the Steering Group also reporting to him.

It was recognised that the sites were too diverse both operationally and geographically to be managed from a central site, but that there must be a communication link between the sites to ensure consistency of standards. It was clear that the four Distilleries could be treated as a 'group' due to their shared organisational structure, location, similar operations and culture, and that for the same reasons Blythswood and Bonhill might also be grouped. For each of these groups, a local safety advisor was appointed and given appropriate training. The Safety Advisor of Blythswood and that of the Distilleries reported to the OHS Team at Strathleven on OHS/Risk issues, and to their local management team on other issues. The site Working Parties aimed to ensure that adequate local resources were in place to implement the policies.

Employee involvement: Safety Committees and Representatives

At each of the sites, safety committees were already in place. The Steering Group recognised that, for these to be effective, there had to be regular (monthly) meetings, the right people at these meetings and, critically, that issues raised at meetings must be actioned.

Issues raised at safety meetings must be actioned.

At each of these sites, members of the Executive Management Team were asked to head the Safety Committees to give the committee authority to make policy decisions and implement real changes. It was also recognised that the Safety Manager or Advisor, Safety Co-ordinators, plus Managers from high incidence rate departments on site must attend, alongside the safety representatives. In most cases, the safety representatives were Union elected, but the company also appointed and trained representatives from the workforce where an area required additional focus. In some cases this gave a development role to individuals with an interest in occupational health and safety training.

The Steering Group recognised that the Safety Representatives role could be expanded from the basic statutory rights to site inspection and consultation about changes to plant and premises detailed in the Safety Representative and Safety Committee

Regulations 1977. It was determined that as Safety Auditors these rights would still be exercised but in addition, with the right training the safety reps could audit against specific standards, procedures and safe systems of work. The Safety Reps would help identify non-conformances and raise them as corrective actions, before an accident happened.

Line management involvement: Safety Co-ordinators

The Initial Status Review had suggested that, for OHS to be effective at a site as large as Strathleven, the responsibility must be taken on by Line Managers and their employees rather than by the OHS department. As a first step in providing the skills on site, 6 middle managers with structural and departmental responsibility, were given NEBOSH Certificate training and a higher level of responsibility for safety of employees in their area. These *Safety Co-ordinators* attended the safety committee meetings along with their safety representative on behalf of their area.

The Co-ordinators were required to manage the safety management system and apply the standards, procedures and safe systems of work on an on-going day-to-day basis. They were required to identify training needs and to arrange for appropriate training to be carried out. Within this role they would fulfil the legal requirement under the Management of Health and Safety at Work Regulations 1992 to appoint persons competent in OHS noting that this legislation requires the company have appropriate 'in house' expertise.

At the Distilleries and Blythswood, the Safety Advisor reported on safety issues to each Production Manager, and communicated directly with the Line Managers on each site. The Co-ordinators were responsible to their existing (usually production) line management.

2.2.2.5 Practical implementation of safety standards

The Steering Group had already decided that the Policy and associated standards must be universal to all sites as there had to be a consistent standard for occupational health and safety within the business. The Group had then determined the OHS standards to

be developed from the commitments made in the Policy and had focused specifically on these commitments and on risks inherent to the business. In the next stage, the group decided how the standards would be implemented and communicated and what documentation would be required. This was by far the greater intellectual and physical real-world challenge.

Dissemination of information

The method of implementation was,

i) through the issue of the Policy Manual to all key individuals,

ii) setting out safety standards and procedures through on-site work instructions and training.

The key individuals included the Managing Director, the Executive team, the Management team, the Safety team and the Safety Co-ordinators. Clearly tasks varied from site to site, but the actual safety standard remained consistent. For example the need for and height of guard rails, or minimum working temperatures.

Risk assessment

All operational tasks on the sites had related work instructions, as required under the ISO system. The ISR had revealed that many of the work instructions did not include safety requirements, and in some cases contradicted OHS requirements – a very clear argument *against* the separation of quality from safety. The original work instructions had been written to ensure a quality product, rather than focus on the human interface with the operation.

At each site, therefore, all tasks were risk assessed by a nominee from the site risk assessment team who were accompanied by the area safety representative. The relevant employees based at the workstation or task were also involved. The initial risk assessment team were trained by a 2 day in-house risk assessment training course. The course started off in the classroom focusing on the principals of risk assessment and then took a practical focus with case studies relevant to the participants and assessment of actual work areas. The team were not given additional payment for

attending training or conducting risk assessments, and comprised the Site Safety Advisors, Safety Co-ordinators, Safety Representatives and most Line Managers. After the initial series of courses, additional risk assessment training was given on-the-job on an adhoc basis by the Risk Manager and site Safety Advisors. A work instruction - comprising a worked example and checklist - was drawn up to help prompt those that carried out risk assessments infrequently. A follow-on set of risk assessment courses was carried out after two years, in addition to adhoc training on request.

In most cases risk assessments had previously been carried out, but these operations were reviewed to ensure the assessments were up to date and reflected current work practice, legal and company standards. Risks were identified and evaluated for all tasks and operating areas and then appropriate controls (corrective actions) were identified for each of these risks: whether to retain the risk and monitor the situation, eliminate the risk altogether, or implement an engineering or human solution. To guide this process it was clearly essential that the standards were simple, easy to follow, non-bureaucratic, brief and useable.

The Working Party at each site considered the original Work Instructions and the results of the risk assessments, integrated them with OHS requirements, and reissued them via the ISO 9001 system as 'Safe Systems of Work'. These were communicated by local team briefs, safety notices, by Line Managers, and during training and retraining.

Case Study

An original ISO 9001 instruction focused on the product instead of safe access. It required the employee to collect a sample bottle, stating that access should be gained to the machine by opening a interlocked guard door, rather than stopping the machine first.

Management Review

A periodic status review was also designed to assess the overall performance of the safety management system. The Steering group decided that the system should be reviewed in full every year with an interim review on a 6 monthly basis. The review was to assess a variety of factors including : audit findings; results of safety

performance measures; legislative changes; structural and organisational changes; and all other relevant internal and external factors that may influence the system. The information for the management review was collated by the Health and Safety team at each site, and evaluated by the Working parties and Steering Group. This review is intended to,

i) maintain the *freshness* of the Safety Management System,

ii) establish if the Safety Management System is adding any value,

iii) collate the results of the ongoing performance measures for presentation to Senior Management.

Other reviews

In addition, periodic reviews were built in to ensure the components of the system were still relevant and continued to be effective. The SMS was maintained in a similar manner to the ISO system with the Policy and Organisation Section being reviewed annually or if there had been Organisational change. The standards and procedures are also reviewed annually or in the event of a change in legislation or standards, new information, operational change or if a need for improvement is identified (or enforced by HSE!).

The safe systems of work are amended every two years or, as a result of risk assessments, corrective actions, new equipment, new tasks or investment, audit findings and safety inspections.

Finally, documentation is reviewed every 1 to 2 years to identify improvements and eliminate excessive paperwork.

As a whole, the components and priorities of the safety management system are reviewed and amended as a result of the safety performance measures. The set of safety performance measures implemented on each site, and by the company overall are of no value if they do not indicate where standards have improved or deteriorated, what areas required focus, and what methods of achieving focus have worked.

2.2.2.6 Communication

Communication is key to the introduction of a SMS and a number of techniques were used to ensure effective transmission of information, primarily the involvement of all sites through the Working Parties, Safety Committees and the Steering Group. This aimed to ensure that employees at all sites were involved right through the process.

Many employees were involved in the initial status review and again during the identification and assessment of risks in their own work place. The site safety committees were kept up to date regularly during the first year of system development. To retain their interest it was vital that they were involved in the process and that there was regular flow of two way information.

The Safety Management System was launched at each site by presentation to all employees by the site Working Party, and further presentations were made to the management team and Safety Committees.

Finally, the training team and line managers in each area launched the safe systems of work, as they are task specific. The involvement and participation of employees in safety management is discussed in more detail in Section 4 'People and Participation'.

2.2.2.7 Performance measurement

The OHS management system was implemented to improve the standard of occupational health and safety across the business, so clearly performance measures were required to assess whether this had happened or not, and where there was room for improvement. There is a difference between *performance measurement* and the overall management review. The management review assesses the overall effectiveness and directs the emphasis of the management system, whereas performance measures assess the standard of safety itself.

Safety performance measures must be a combination of quantitative and qualitative measures, such as accident rates, audits, surveys, awareness and the cost of

occupational health and safety. A different set of safety performance measures was appropriate for each individual site, and for the company as a whole.

Depending upon the nature of the measure, it could be used daily (hazard identification), weekly, monthly, annually or as infrequently as every 2-3 years (employee interview). The combination and frequency of these measures and a discussion of their effectiveness is considered in Section 3 *'Performance Measures'*. The key point here is that performance measures are only of value if the information they provide is accurate, timely, comprehensible, provides a valid indicator of performance and, critically, a path to improvement of that performance.

3 SAFETY PERFORMANCE MEASURES

3.1 WHY HAVE SAFETY PERFORMANCE MEASURES ?

Concentrated effort and resources can be focused on safety management with the aim of improving the status quo. However, without knowing the starting point or baseline, an organisation can have no idea of how far it has progressed or digressed in the pursuit of continuous improvement.

Initial status reviews, which were mentioned earlier, aim to establish the baseline safety status of an organisation after which a series of modifications will be implemented. The results of this review will highlight deficiencies and indicate what changes are actually required. However, this is only possible if the initial status review has been conducted proficiently and covered all aspects of safety. As an initial status review is an isolated study, many different discrete techniques can be applied, however, a different approach may and will be required for ongoing measurement of performance.

To further complicate matters, the performance indicators that are commonly associated with production, Quality or Engineering, and familiar to managers, are not necessarily suitable for the measurement of safety management. Safety has different concerns in that it focuses on people and legal requirements rather than on product quality or process efficiency. Many aspects of safety are entirely subjective, such as attitude, and may not actually indicate how people perform. Safety performance measures then have a dual requirement in the inclusion of both hard and soft measures. 'Hard' or objective measures include accident statistics, a contrast to soft measures like attitudinal surveys or the impact on safety awareness of training. It is also important that at least some of the indicators selected are positive and proactive rather than reactive and post-facto.

In the 1997 edition of Successful Health and Safety Management, the HSE propose that a business implements a combination of active and reactive measures. They propose that a company measures and rewards achievement instead of focusing

purely on safety failures and deficiencies. The HSE suggest that whilst investigation into deficiencies creates an opportunity to 'learn from mistakes', valuable knowledge should also be gained with proactive techniques such as behavioural observation, inspections and auditing. In contrast, in the first edition of this publication in 1991, the focus had been on reactive (negative) measures of safety performance such as accident and incident investigation. In the interim period, the HSE have recognised that a combination of both active and reactive, hard and soft measures of safety is more effective in gauging performance and enabling improvements. It may be that intermittent contact by the J&B study group with key HSE specialists from the Accident Prevention Advisory Unit (APAU) played a small part in the this change in emphasis as the inadequacy in practice of the reactive systems proposed in the 1991 (and earlier) documents was very firmly stressed. On the other hand, it was clear in those discussion that within HSE there existed recognition of the same problem – that management could only *react* to the older measures, whereas there was a need to *drive* the performance of the organisation.

Performance measures must also be appropriate to a company's culture, management structure, expertise, risks and resources. It is obvious that a complex tailor-made comprehensive system may not be suitable for a small company or site with few operational risks and fewer resources. In contrast, companies in the nuclear and oil industries often use very complex systems of measurement and monitoring. Leading on from that, it is also true that a system or technique of measurement should be also be understandable and usable by those who will be required to operate it. The measures of performance must also be useful in practical time-scales to line management, rather than waiting for years for useful results. They must have consistency of approach and meaningful results to allow year on year comparisons. The techniques must reflect the current set-up of the company, and it must be noted that some historical data will be rendered meaningless if there has been a series of organisational changes.

There are many techniques available to companies, from self-administered systems to elaborate techniques that require specialist assistance. Companies can custom

design measures and system for themselves. It is critical that whatever technique/s or system is chosen that they perform fulfil certain functions : continuity; accuracy; consistency; utility; meaningful information. This information should indicate current status, identify areas of concern and help to facilitate continuous improvement. This is unlikely to be achievable through one technique alone. This section aims to consider the different techniques that are available, and suggest solutions for practical implementation into the work place.

3.1.1 SAFETY PERFORMANCE INDICATORS

A technique that measures health and safety performance in the workplace should provide an accurate picture of current status whilst providing useful information that will enable positive improvements to be implemented. An ideal technique will not require a health and safety expert to use it, nor be cost prohibitive for smaller companies yet will provide useful information at intermediate and higher levels. It should be available, accessible and provide timely information for all interested parties, especially those who implement safety tools, the success of which should be measurable using the technique.

As may be expected, the ideal health and safety performance measure does not exist in isolation and commonly one or more complementary measure will be used for their individual properties.

In industry, three main techniques are currently used, occasionally together, to provide the feedback required for management and improvement of safety performance:

- Monitoring
- Auditing
- Intensive studies

This section offers criticism and appraisal of the three techniques commonly used to monitor and control safety performance.

3.1.1.1 Monitoring

The technique of 'monitoring', otherwise known as the study of accident data, is almost certainly the most commonly used health and safety performance measure used across all industries. Monitoring is the collection and analysis of data on accidents, whether injury or non-injury, near-misses, or costs that have occurred over a period of time. The analysis will generally focus on comparison of accident experience by quantity, frequency or type over a period of time. Other comparisons maybe made, for example : across departments; sites; within an industry or against national averages.

Perhaps one reason for its widespread use is that it is, and has been, a legal requirement to collect and disseminate information about 'reportable' accidents to the enforcement bodies since the introduction of the Notification of Accidents and Dangerous Occurrences Regulations in 1981. The majority of companies already collect accident data so it is readily available to them and in some respects it is the most accessible performance measure to non-safety professionals. However by the nature of its simplicity, it is also the technique easiest to misinterpret and it is open to abuse.

One thing is immediately clear, monitoring is the *numerical* comparison of events against those occurring at different locations or periods of time. The critical assumption in relation to monitoring is therefore that 100% reporting of all events that take place, collected in the same manner, to allow 'true' numerical comparisons. If there is incomplete collection of all event data, there will not be an accurate comparison. Typical scenarios such as a change in a reporting system, change of emphasis on accident reporting, change of management team or fear of blame, will alone be significant enough to influence the number of events recorded on a year on year basis.

These scenarios are independent of an actual improvement or decline in health and safety performance and can easily produce misleading results. For example a new

management policy introducing bonuses for a 10% reduction in the number of accidents in one year is likely to result in under reporting of accidents across the board, rather than an actual reduction of accidents. These circumstances will demonstrate a significant improvement in performance, whilst inadvertently creating a 'blame' culture. Alternative scenarios that will render prior data as meaningless are the down-sizing of the work force or introduction of temporary workers, change in work practices (for example, automation), fluctuation in the number of working hours - specifically change in shifts, or overtime or any other similar factors. Data can be compared using ratios in some circumstances, but direct comparison of raw accident data will no longer be valid.

Alternatively there is a risk of collecting too much information. This has been described by Shannon (1993) as opening a window to get a clearer view, but letting in more dust to obscure it. Vast quantities of information will result in data handling problems. Even with the aid of an appropriate database, data logging and analysis will be time consuming. This may result in more emphasis on the collection of information than on the interpretation of the results.

To add further complications, the amount of accident data that has to be gathered will have to be large in order to achieve statistical stability, if it is assumed that the event rate follows a Poisson Distribution. In Table 2 it is demonstrated that with a current annual rate of 20 reportable accidents, it would take 19 months at a 50% reduced rate for the change in the mean rate to be identified with statistical confidence. The impact of training or any other campaign would not become clear for almost two years. If there are large number of events, a statistically identifiable reduction will take a shorter period of time, but as a company improves its accident performance, it will become increasingly difficult to demonstrate that there has been any change at all. In addition, and very importantly, at this level accident data is distorted by one or two individuals who have been affected by events external to the workplace. See Table 2:

Table 2

Time to register a 50% reduction in accident rate from initial rate	
Initial accident rate (events per year)	No of months for 50% reduction to be significant at 95% confidence interval
400	1
50	8
20	19
10	38
2	192

In summary, monitoring has benefits as a benchmark against which to compare health and safety performance. The technique is, however, a post-facto measure of performance as it only reports what has already gone wrong and results in the negative image of the safety professional who 'always provides the bad news'. For this reason and those outlined above this technique must be used with caution, and preferably with a positive performance measure to complement it.

3.1.1.2 Rating systems

An Audit or Rating system is typically a system - either proprietary or custom - that describes areas of management and asks a formalised series of questions about factors within each of these areas. A rating is produced for each area and an overall assessment is based on these scores and the distribution of scores across areas. Although much of the rating is performed by interview, hard evidence is also assessed to show that an organisation's systems or procedures are in place and are being followed through site inspections and documentary assessments.

Rating systems require belief that the factors controlled have a direct positive impact on safety. It is, however, probable that although they do have a direct effect, the main impact is indirect through enhanced management performance. At worst, the rating factors themselves become goals or check lists with no impact.

Experience with such systems suggests that the most common flaws are :

Weighting problems

Most systems place high value on having formalised management systems in place as opposed to in operation. Although it is true that such systems are necessary it is not true that existence alone justifies this high rating.

Subjectivity of respondent and false positive answering

The belief that an organisation is good can be reflected in the responses to questions and, because physical checks are generally limited by time, this can permeate through to a rating 'hike'. More critically, individuals who are brutally honest during the audit may achieve a reduced score in comparison with others who paint a rose tinted vision of their department.

Subjectivity of audit team

To obtain any sort of trend analysis from audit to audit there has to be continuity in the marking of the audit and comprehensive records must be kept of the definitions used and those scores that are produced after discussion. The audit team must have health and safety expertise, which may not be available within a company.

Emphasis on larger sites & organisations

Most audit systems are appropriate to organisations with layered structures of management. Where smaller sites are being considered, results can be skewed by the knowledge/responses of a few people. Audit systems for smaller sites exist, but there are difficulties in integrating these into one unifying report if part of a larger organisation.

Personal reactions

First is the effect of repetition on boredom thresholds - without a doubt such auditing can be monotonous for the interviewer and interviewee alike. This is of course subjective. Furthermore, the questioning can become overly interrogative and lead to positive acquiescence or defensive answering. Ignorance can be identified, but false

answering, especially at higher levels in an organisation, cannot. Reliance then falls on the auditor to reveal the truth behind all of the answers given in interviews, a time consuming task and difficult task.

Audit systems, it is suggested, have an effect at higher levels in an organisation by ensuring that 'good' management systems exist. They do not, therefore, offer assistance in the day to day management of safety other than by providing framework systems for operating safely. In any event, the ratings achieved year on year or compared across organisations can have no true significance, as they would require truly objective standards of assessment. Each audit should be seen as one unique observation to highlight areas of management in general that requires some action.

An auditor however will create a summary report of system failures, defects from the physical inspection and lack of documentary evidence. Enhanced management performance can be achieved by the inclusion of safety objectives from defects identified in the audit into managers' annual bonus objectives for example: ensuring that risk assessments are completed in their area; ensuring that safe systems of work for all tasks are written; or carrying out monthly safety inspections. Obviously, the objectives must cover areas other than accident performance.

3.1.1.3 Intensive studies

Behaviour

Concentrated observation is carried out by an individual or a team who have a description of a 'safe system of work' for an individual. The actual behaviour of the target individual is compared with the safe system of work in the attempt to identify where errors are being made, with the aim of pro-actively identifying the cause of accidents. For example : failure to wear personal protective equipment; failure to isolate machinery before maintenance; failure to follow procedures. Controls can then be implemented before an accident has actually happened.

Where concentrated observation of task performance and unsafe acts is used as an alternative to or in addition to recording of incidents and accidents this, also, requires a great deal of resources. Intensive observation of behaviour, however, is based on the theory that unsafe behaviour is directly linked with the occurrence of incidents and accidents. It is likely, however, that the simple assumption of a continuous distribution from unsafe act to large accident will be incorrect. It might be conservative because major accidents tend to bring together a number of unsafe acts, the combination of which is difficult to anticipate. As Waagenar (1988), for example, has demonstrated, the number of *errors* required by each individual to lead to an accident will decrease with the number of people involved.

A more basic problem is the resource required for the concentrated observation and the nature of the assessment. Only skilled observers can assure that events are being counted on an equal basis, and yet even so observation is, by inference, subjective. The addition of another person to 'verify' the observations requires additional resource. It is unlikely that intensive observation can be used as a measurement system by middle management, it is time consuming and requires specialist trained resource.

It is worth repeating, however, that the basic premise of this technique is sound - that unsafe acts or errors may lead to the occurrence of accidents, either in isolation or by combination, and therefore the identification and control of these may lead to improved safety performance. A more cost and resource effective technique may be the introduction of near-miss reporting and a system of hazard notification where all personnel are actively encouraged to report situations before an accident occurs. The side effect of this is importantly, the active involvement of all personnel in the system irrespective of their skill or training in 'observation'.

For companies who operate using ISO (International Standards Organisation) systems, it will be possible to analyse non-conforming behaviour against procedures and safe systems of work as an integral part of their auditing system. The identification of non-conforming behaviour will indicate that the safety management

system is not working properly, whereas the experience of accidents, like quality errors, indicates that the system has already failed.

Attitude

An attitudinal study, in this context, sets out to capture the attitude of a work force or management towards health and safety in the workplace. Such a study may be carried out by interview or questionnaire. The results of the study will, in principle, provide a benchmark for comparison with previous studies to determine if the company has an improved attitude towards safety.

Value from the performance of an attitudinal study would come if there were a definite link between safety attitude and resultant behaviour and therefore the occurrence of accidents. That is, improved attitude towards safety will result in a reduction of accidents and improved safety performance. Research studies, however, suggest that this link is tenuous if it exists at all. For example, very few individuals will respond in a study that they have a negative attitude towards safety, and yet clearly accidents still occur. Attitudinal studies capture the 'expressed' attitude or 'intention to act' of an individual. This may not be indicative of *actual* behaviour. Glendon and McKenna (1995) give the example of workers who wear personal protective equipment when working alone, but fail to do so when operating within a group. How then can attitude be a reliable predictor of safety output, if behaviour is modified so precisely by circumstances ?

Instead, the study should set out to capture information about levels of safety awareness or knowledge for it to be of any practical value at all. It is suggested that an 'awareness' study that focuses on the knowledge and understanding of very specific issues will be more indicative of actual behaviour than those on more general issues.

An awareness study may be useful for the identification of training or information needs for the study group and it may also suggest reasons why accidents of a particular type have been repeated in an area. It is not, however, an accurate or

scientific guide to health and safety performance. The study must be carefully designed so as to avoid providing meaningless or misleading information, or confusion for the respondent and the method of data analysis must be carefully considered beforehand to avoid non-causal correlation's such as 'the awareness of the need for hearing protection has increased with paper consumption on site'. Issues of interpretation of such studies require expertise in design, performance and analysis of an awareness study. Expertise that may not be available within a company. The performance of a study will require the availability and time of all participating individuals.

It is suggested then, that a specific awareness study may be worthwhile if it is expertly carried out on a 3-5 yearly basis. It should be used as a bench marking exercise only, rather than a true measure of health and safety performance.

3.1.2 SUMMARY

Each of the techniques has a specific role in the measurement of health and safety performance. Every organisation will have different issues, standards of safety, resources and development needs, much like the individuals within their business. A tailored system of performance measurement that will facilitate continuous improvement should be introduced, with enough flexibility to assure continuity and yet provide for modifications as standards of health and safety progress. Only the measurement of health and safety performance using an optimum mix of techniques, relevant to each situation, will result in the desired improvement.

What follows is a series of Case Studies implemented within J&B Scotland between 1994 and 1997. In each Case Study, a performance measure has been implemented, and it is appraised in terms of how practical it was, and the benefit, if any that it provided in the pursuit for continuous improvement.

3.2 MONITORING OF ACCIDENT RATES

3.2.1 AIMS

For a system to be controlled it has to be measured. Monitoring of accident (or incident) rates is the most widely used performance measure. Its combination of the apparent *hardness* of numerical measuring with easy and vivid graphical presentation makes it attractive. Its utility has not, however, been widely discussed.

The aims here were to,

i) identify and test techniques to detect changes in the statistics of the accident process.

ii) analyse the accident information for the period 1990-1999 to determine if there had been (statistically) significant changes in the number of accidents in this period

iii) create a statistical model that would indicate (forecast) accident rates in the future based on past results for certain work periods and situations. The obvious inverse of this is the ability to highlight those work processes with higher accident rates.

Clearly, the last two objectives depend to some extent on the first. Before any analysis, however, the information that is available has to be reviewed and checked for quality.

3.2.2 REVIEW OF DATA

3.2.2.1 Form of information

The form of information available is important. At J&B we have incident occurrences that have been gathered as *raw* rates in time. There is the potential to *normalise* the rates using information about other variables (for example man hours) that may be important to the rate of incidents and by doing that to test the linkage. We also have the incidents categorised by type – serious, first aid, non-injury etc. and this allows investigation of the relationships between type of accident.

A difficulty is that no coherent records are or have been kept of the *normalisation* variables on a monthly basis. They exist only as annual values. Attempts were made to obtain the information and to persuade the relevant production groups to record useful monthly information, but because of Group recording procedures this was not possible. That represents a serious problem for analysis as one would not wish to use accident measures without taking account of the intensity of work. This inability to record useful data at site level may very well be a feature of the industrial setting where holding groups drive the marketing and production effort and individual companies are accounted within an overall scheme.

3.2.2.2 Rates and development of mean rates in time

Figure 1, therefore, shows only the raw information for minor and reportable accidents. Although one should not attempt to read to much into this, it seems that there is a period from mid 1993 to early 1996 where the rate for the minor injury category is lower than elsewhere. There is a rise through 1997 and then a fall to the end of 1998. For clarification, J&B defined minor accidents as injury accidents that incur less than 4 days lost time from normal work, and reportable accidents as injury accidents resulting in more than 3 days lost time from normal work.

The structure of the information is, however, more clearly seen in Figures 2 and 3. These show the development of the mean rates for minor and reportable accidents respectively. They also show the development of the standard deviation of the results and the 95% confidence intervals of the mean. On Figure 2 it seems clearer that the mean rate of minor accidents has fallen slightly over time – certainly since early 1993 – so that it now lies around 6.8 from a value around 8 prior to 1993. The reportable accidents shown in Figure 3 show an apparently more dramatic fall, but the reader should be beware of scales and their effect – useful when presenting to senior management. The rate does fall from around 2 in January 1992 to 1.15 at the end of the recording interval.

On both figures it is interesting to look at the standard deviation of the data and the standard deviation of the mean (more usually called the standard error). It is

common in accident work to assume that accident rates follow a Poisson distribution (Chatfield, 1983). It is supposed that accidents occur randomly in time about a mean rate. An important feature of the Poisson model is that the variance is equal to the mean so that the standard deviation is the square root of the mean.

Table 3

Category	√(mean)	Standard deviation
Minor	2.6	2.9
Reportable	1.1	1.2

This is almost true for both of the processes shown here and that is re-assuring.

It is also worthwhile pointing out the relative stability of the standard deviation (and hence the variance) in both cases as this makes some of the possible tests for changes in the mean easier.

On the other hand, it is built into the Poisson process that variations are random about a mean rate. For *raw* accident data this may very well be true, but for information that takes account of work load – that is normalised values there will be confounding factors that destroy the theoretical process.

3.2.2.3 Frequency analysis

One of the (apparently) easiest tests is of cyclic frequency as many standard packages will perform Fourier analysis of the data to identify recurrent cycles. It is possible, however, for an inexperienced person to obtain widely different results from the many different manipulations that are required on the data. For this study help was sought from an experienced analyst and the results are given in Tables 4 and 5.

Table 4

Minor accidents			
	Frequency (sec^{-1})	**Period (months)**	**Period (days)**
Raw	0.333	3.0	91
	0.416	2.4	73
With filter	0.333	3.0	91
	0.416	2.4	73

For minor accidents there is a clear 3 monthly cycle that ties in well with the cyclic nature of whisky production centred around the major holidays – still *quarter* days in the UK and Anglo centric world. The 2.4 months or 73 days cycle is less pronounced and may (I am told) be a function of variations produced by world-wide trading. Filtering of the data retains the same frequency peaks so that they seem solid effects rather than artefacts of analysis.

The true production cycle of the Company cannot be reproduced from production information, however an increase in production coincides with the lead up to Christmas and New Year, and the summer holiday period.

Table 5

Major (reportable) accidents			
	Frequency (sec^{-1})	**Period (months)**	**Period (days)**
Raw	0.073	13.7	417
	0.163	6.1	187
With filter	0.073	13.7	417
	0.16	6.3	190
	0.32	3.1	95
	0.35	2.9	87

For reportable accidents where the incidence is very low, the frequency analysis is less clear. There is a (possibly) annual cycle that may be a function of the limited period of data capture. There is a clear 6 month cycle and a probable 3 month cycle that, again, are likely to be tied to production demands from Group Marketing.

Overall we learn little from such analysis except that it requires experienced personnel to separate the wheat from the chaff – even to produce wheat.

3.2.2.4 Cumulative sums of differences

Two possible techniques exist to detect changes in the mean of a process. One uses the 'student t' distribution and the other the cumulative sum (CUSUM) process that derives from quality control experience. They are essentially the same in that they are an extension to standard quality control procedures where excursions beyond a limit are measured, to take account of the time period.(Leavenworth 1996; Ryan 2000)

Both cumulative sums and tests for changes in the mean provide quicker identification of underlying changes than most QC *Shewart* charts where only the immediate level is tested. The cumulative sum adds up the differences over time from some assumed mean level and looks for changes in slope. If the line is flat there is no change. If there is a slope over several readings then a change in the mean has occurred. It is possible to set slope limits that identify shifts in the mean of the process being considered. Student's 't' test performs essentially the same task for small numbers of samples, but is less visual.

Figures 4, 5 and 6 apply these techniques to the minor accident category. Figures 7, 8 and 9 are similar for reportable incidents.

Considering, first, Figure 4, we see a rise in slope of the CUSUM until about April 1993 when it falls steadily until January 1996. It then rises again to a flat period in mid 1997 before falling to the end of the recording interval. On this Figure are also shown points in time where the 't' test (taken over 5 points) suggest a probability

greater than 60% of a change in the mean of the process. Obviously, this is *post facto*. Furthermore, it is taken over a five month interval before and after the date in question where the five month interval avoids possible three monthly and six monthly resonance's, but this would not be obvious to anyone who started such a scheme.

Figures 5 and 6 split the CUSUM process into those changes that are above the mean level and those below it. To remove any *noise* from the Figures, those changes that are less than half a standard deviation of the overall process are neglected. Figure 6 takes out and plots the *local* mean value and shows what is left – the residuals.

The CUSUM (Figure 4) suggests, for example a change in April 1993, whereas the 't' test suggests January 1993. Differences are small, however, and the lag is a matter of months. The CUSUM, therefore has possibilities as a guide to significant (in the statistical sense) changes in what is going on. It is not, however, as quick as may be thought from the plot in Figure 4. It is not immediately obvious, for example, in May 1997 when the underlying process changes – it could be May or June or July. As noted in Ryan (2000), the CUSUM technique is at its best when there is a sudden and quite large change in the mean.

Figures 5 and 6 show this more clearly. Although there is a general trend downwards in minor accident rate, the changes are small and the scatter (residuals in Figure 6) is quite wide. The most significant (not in a statistical sense) change from our point of view is round about June 1997 when there is a drop in the minor accident rate.

Again it has to be stressed, however, that these tests are operating over periods of months (5 or more). That has little value for a production manager.

The same analysis is provided in Figures 7, 8 and 9 for the reportable accidents. The *huge* problem is that, whereas Figure 7 seems to show a clear change in April 1997 in the CUSUM, this is not reported (at any level above 0.3 probability) by the 't' test.

Taken over a longer interval the test is positive in that period of time, but observation of Figure 7 shows relatively wide scatter from 1994 to 1997 and a slow decrease in the CUSUM. The test cannot distinguish the change in early 1997 well. Much of this is due to the very small level of events taken on a monthly basis. Events are discrete at one, two or three a month (see Figure 1) and it is not mathematically possible to detect slow changes in any reasonable interval. Again, not useful for a Production Manager.

Figures 7, 8 and 9 are, however, interesting as they confirm a steady drop in reportable accident rate over the period of the study. Or do they??

3.2.2.5 Normalised data

Perhaps they don't when *normalised* variables are used. Figure 10 gives annual information about the obvious normalising variables such as cases of spirit produced, hours worked and staff numbers and Figures 11 and 12 present the minor and reportable accident rates (on an annual basis) once they have been divided by these normalising variables. There is quite a change from the *raw* information.

No statistical tests provide useful information on these results over the time intervals. A mean line is about all that could be plotted and that without any confidence (statistical or otherwise). What can be said, however, is that the rate of minor accidents per million cases has either dropped or stayed constant, but the rate per hours worked and staff employed grew over the time of recording. The same is probably true of the reportable injuries where, certainly, the rate per hours worked has increased.

Many factors other than an improved or degraded performance in safety can lead to reduced or different accident rates. The restructure or downsizing of a company or other significant organisational change can impact on accident data. It is therefore critical in year on year comparisons that the comparable number and type of employees and activities are considered. Similarly, seasonal fluctuations should be kept in mind as rates will generally vary with production rate and hours worked. In

this case study there were significant seasonal trends and corrections would ideally be required between actual rate and number of hours worked.

3.2.2.6 Accidents and production series

Figure 13 shows production efficiency over the same period where this is taken as production per employee and production per hours worked. These are essentially the same variables. The production efficiency is seen to have risen dramatically (by a factor of 2.2 from 94/95 to 98/99).

If the increasing production was due to improvement in technology, then production would be directly related to the number of working hours plus the benefits of the improved level of technology available. If this were achieved without an increase in risk then the accident series per hour worked and by cases produced, the two series might show a similar shape *and* be in proportion. Figures 11 to 13 do not show this. Figure 13 suggests that numbers employed and hours worked are the same and that productivity has increased dramatically. Figures 11 and 12 do, however, show precisely similar patterns for accident rates per hours/employees and for production (millions of cases) with the values for 1998/99 being the odd ones out. The correlations are of interest. The correlation coefficient between cases produced and hours worked (and employed numbers) is about 0.5. Emphasising the increased production per unit resource and although only small numbers of points are compared, this suggests that there may be a significant technology effect.

It would be interesting to examine the effect of overtime on accident frequency rate. It would be interesting to determine whether an increase in accident rate is due to increased pressure to produce, longer hours, tiredness, or shift work or a combination of these. It would be interesting to try to confirm what is generally known by safety professionals – that when there is more work pressure, when more overtime is worked, when casual labour is brought in to cover for redundancies and when lay-offs occur; then the rate of accidents rises. Human resource management takes little account of this cost. All interesting but impossible as the information is not available over a period longer than one year, and therefore is not stable. The

availability and consistency of information, and its instability are clear disadvantages of using accident data.

3.2.2.7 Multi-variate regression techniques

One possible way to isolate calendar/production rate influences would be by modelling these effects to modify the recorded levels – much as the Government do with unemployment and other indices.

The advantages of statistical models that summarise data and test hypotheses are well documented. Regression analysis, for example, examines the relationship between a dependent variable and a set of independent variables. Analysis of variance techniques provide tests for the effects of various factors on a dependent variable. Neither technique, however, is appropriate for categorical data or fully appropriate where the observations are not from a normally distributed population with constant variance – generally, therefore, where sample size is small.

A special class of statistical technique, called Poisson regression or log-linear modelling, has been formulated for the analysis of categorical data and it has been shown above that the raw data seem to follow the Poisson model well. This technique can be used in calculations where the response variable represents the number of events occurring in a fixed period of time and the models are useful for uncovering the potentially complex relationships among variables in a multi-way cross tabulation. Log-linear models are similar to multiple regression models and in the J&B case, the classifications (year, month and class of accident - whether minor or lost time) are used as independent variables, and the dependent variable is the number of events, (accidents).

3.2.2.8 Accident data defined

The data set contained the number of accidents per month within J&B in the period January 1990 to December 1998 divided into three classes as follows,

1 *First Aid* injury accident : An injury treatable with first aid only, with no associated lost time

2 *Minor* injury accident: An injury which, although more serious than a first aid accident, leads to less than 4 days lost time from normal work

3 *Reportable* accident : Four or more days lost from normal work and/or reportable under the RIDDOR Regulations.

This differs from the previous analysis in that the minor accidents have been further subdivided to examine the nature of the smallest incidents.

3.2.2.9 Significance of categories

Preliminary evaluation suggests that all the main effects of class, month and year are very significant. This means that the rate of accidents differs significantly depending on class, month and year.

Class of accident

The fitted value of first aid treatable accidents is positive and much higher than that of the others, meaning that the frequency of first aid accidents is significantly higher than the other two classes. The second highest class is that of minor injury accidents, and the lowest, reportable accidents. This dispersion is to be expected under normal operating and reporting conditions, and follows the pattern suggested by the accident triangle.

Seasonal Variation

The critical level of the factor 'month' is very small. This suggests that seasonal variation does exist. From the fitted value of 'month', we find that the number of accidents are significantly higher around the period September to November. The lowest occurrence is in July and the fitted value suggests that it is markedly lower than the other months. In the period from January to February and from April to May, the expected numbers of accidents are lower than the average.

The seasonal variation reflects fluctuating periods of production. Within the company the highest period of production is in fact, September to November where there are also high levels of overtime worked. In July, there are only 2 weeks of production due to the summer maintenance shut-down. The quiet period is January, February. In April, there is also a two week shutdown period, after which production steadily increases. Evidently, the rate of accidents is linked to periods of production activity.

3.2.2.10 The second order interaction effect – all data

A significant three way interaction effect does not exist. However, the two level interaction effect of class*year and month*year are significant. In essence, the class*year interaction means that the three different classes of accidents have different distributions across the period 1990-1995. The frequencies of first aid accidents decreased rapidly but the frequency of the other two classes of accident were quite stable in yearly figures with only small fluctuations. This was further proved by analysis of only minor and reportable accidents. Although first aid accidents decreased significantly, the other classes remained fairly stable, whilst maintaining their relationship to one another. The implication is that they behave similarly – first aid accidents are the odd ones out.

The other second order effect of month*year is also significant. Accident rates were lower in July, April and January and higher in September to November, perhaps showing a positive correlation to rates of production whilst low and then high.

No significant interaction effect was observed for either the three way effect or for the second order effect of class*month. Hence, all the first order effects and only two of the second order effects (class*year and month*year) could be used to represent the data

Analysis was then performed using only the two more severe classes of accident (minor and reportable), the result showed that there was no interaction effect on class*month or class*year. This means that the distribution of the two different

classes of accident was the same, and that they were only different in proportion. Therefore we can combine these classes of accidents into one. As a result of this, the frequencies within the cells were higher such that no cell contains less than 5 accidents. The benefit of this is that the number of accidents within the sample increases, and as a result the estimation becomes more accurate.

3.2.2.11 Estimating the expected frequencies of accidents

Based on these results and selecting only those variables that are shown to be significant, models can be produced to *estimate* the expected frequencies of accidents in the time interval considered or to develop a model of the *correction* for each month. Pragmatically, there seems little value in this.

3.2.3 OVERVIEW AND UTILITY OF STATISTICAL ANALYSIS OF DATA

Whereas raw accident information seems to show slight falls in rates over time, the true picture is of a rise in both minor and reportable accidents per unit volumes of work over the period of the study – essentially from 1996. This could be disheartening if it were not for the knowledge that revision of the system of recording to make it simpler, encouragement to record events and increased involvement in safety would all act to confound the results. Where emphasis is put on safety event records are expected to rise.

It is clear that the tests for changes in accident rates can be applied to the raw data, but that they have little value for real-time management as opposed to management presentations. It is also clear that normalised variables are essential to allow understanding of what is happening in a plant. They were, unfortunately, not available for this study.

Given that monthly or weekly production information should be available, it would seem sensible to use the CUSUM or students *t* methods to identify changes in performance. It is an open question, however, whether the cyclic nature of the production could be fully removed from the analysis. Regression techniques hold out the hope of doing this, but add their own uncertainty. In any event, it would take

several months to isolate a change and years to develop an adequate regression model.

The multi-variate analysis of the data did produce some interesting information. First aid incidents – the lowest level of accident were found to follow a different distribution from the minor and reportable accidents - the last two being essentially similar in form although not magnitude. That is encouraging when we come to consider accident *triangles* (Section 3.4).

Statistical analysis of accidents can enable *significant* changes to be identified. It can be useful to identify changes over time, such as a change in the severity of accidents. However, because of the nature of the analysis, it requires statistical expertise (not always available), accurate data (again often not available), and results can be open to misinterpretation. The *statistical* instability of accident data means that, even if the data fluctuates and suggests an improvement in the overall trend, this may in fact be inconclusive. The statistical tests that can be performed to identify if there are significant effects are unlikely to be used by the practical safety manager. When a company sets key point indicators such as the reduction in accident rates year on year, it will be tempting to use raw data that shows apparent rate reductions. This will however be inherently inaccurate, unless supporting statistical tests are performed.

Fundamentally, accident monitoring is a negative measure. The techniques could, however, be used every 2 to 3 years to illustrate over time whether overall strategies have been successful and to start discussion, but they will not help individual managers.

There may be benefits in the comparison of units, sites and companies using accident rates, but there are several basic rules that must be applied for accuracy: that there are consistency in reporting; accurate data; and understanding of the limitations of the formulae. The formulae cannot isolate small improvements in safety performance - as often as not these will not be statistically significant, and caused by other factors.

Comparison of trends over time between 'like' units could, however, be used on a pragmatic basis. It is also invalid to make direct numerical comparisons of operations with different risk exposures, although, again, trends upwards or downwards could be compared. Attention must be paid to other underlying factors that may have affected the ratios (or individual incidents), and to other general matters that affect performance such as seasonal trends, motivation and accident triangles. In essence, there are advantages to be gained from analysing accidents, but techniques have to be used accurately, consistently and with expertise to avoid misinterpretation.

Finally, a very serious/catastrophic incident is caused by a rare combination of events and may not be indicative of a poor general performance. Poor or deteriorating safety performance in general can be identified instead by a large number of events of all types and in particular lost time incidents. The tests here suggest that minor and reportable accidents can be grouped together to increase the numbers and, perhaps, speed up the testing for changes. Not all incidents have the potential to be fatal, but certainly in some cases if there has been a large number of potentially serious accidents, it is a fair assumption that one will eventually lead to a fatality or permanent disability.

It can be difficult to collect accurate data over a long period of time. There is a risk of collecting volumes of information and never analysing it, or analysing it but failing to recognise the key areas where action is required. In many cases, Safety Departments do not have the time or the expertise to analyse the data properly, and make false assumptions about improvements or progress being made. Accident monitoring has its place for infrequent progress checks, and evaluation of *types and patterns* of accidents. Monitoring can be used to check rolling progress of accident rates over periods counted in years and more frequently, perhaps annually, to evaluate trends and patterns in type of accident.

3.3 ATTITUDE AND AWARENESS STUDIES

An attitudinal study, as commonly understood, sets out to capture the expressed attitude of a work force or management towards health and safety in the workplace. Such a study may be carried out by interview or questionnaire and the results of the study will, in theory, provide a benchmark for comparison with preceding or later studies to determine if there has been any significant change over time.

It would be a wonderful thing if peoples' attitudes were fixed, but as discussed at length in Section 4.1, attitudinal studies suffer from differences between expressed attitude, underlying action causes and physical behaviour. People have attitudes and so attitudes can be measured, but have these measurements any value to safety management?

Awareness, on the other hand, is a different beast. Studies of how much people know and understand are 'firmer' in that they test knowledge and the depth and extent of knowledge.

In this section we suspend disbelief and discuss a study of attitude and awareness to find out what value it might have and what difficulties there are in its execution. Two methods of capture are used, a questionnaire and structured interviews as, for example discussed in Frankfort-Nachmias et al.(1996) in order to demonstrate two methods by which expressed attitude and awareness can be captured.

3.3.1 QUESTIONNAIRE STUDY

A questionnaire aims to capture on paper the responses to a series of set questions. A number of formats can be used to capture these responses. First, a questionnaire can be issued to individuals or groups, it can be completed with discussion or in isolation, it can be sent out, or handed out, there can be time set aside for completion or it can be completed in the respondent's own time. There is also the option of an interviewer asking these questions, interpreting the results and completing them for the respondent.

Mail and other unsupported paper questionnaires (Fink, 1985) have the key advantage of being relatively low cost to distribute and analyse, accessible to many respondents at once and allow the individual time to consider his or her answers. However as the respondent has to answer the series of questions without clarification from an interviewer, only simple questions can be set (De Vaus, 1991). As the interviewer is remote, there is no opportunity to probe further to gain greater understanding of the rationale behind the responses.

One of the greatest drawbacks of a paper/mail questionnaire is that there is often a relatively low response rate from the targeted group. The response rate can be increased by careful timing of questionnaire distribution, for example avoiding holiday periods, plant shutdowns. In the workplace, one would avoid disseminating questionnaires at peak production periods, or during corporate restructuring, unless of course the questionnaire aimed to capture employees thoughts on that process ! An inducement to respond such as a free prize draw, and an effortless way to return the questionnaire – perhaps pre-paid envelope, or return to ones manager – may also increase response rate. It should be noted however, that return via a Department Manager may also decrease the response rate, depending upon the content of the questionnaire and responses, and on the individuals relationship with that manager.

A telephone led survey is another cost effective way to capture responses, and attracts a higher response rate (Fowler 1993). Direct contact with the respondent enables the interviewer to explain more difficult concepts, and probe further for answers to ensure quality of data, however respondents may be reluctant to discuss sensitive issues, especially if the survey takes place in the work place. Telephone survey can be a useful tool, but is not really appropriate for capturing responses from all employees in the workplace. Of course this would be dependant on the nature of operations, but in some environments many employees will not even have ready access to a telephone.

For the purposes of this case study, a paper questionnaire was deemed most appropriate.

3.3.2 CASE STUDY 1 : COSHH QUESTIONNAIRE

3.3.2.1 Initial study

In 1994, an initial study was implemented to determine site compliance with the COSHH (Control of substances Hazardous to Health) Regulations 1989. In brief, the Regulations require a company to identify all substances on site and assess them in terms of risks to the health of the workforce. Once the risks have been identified, they must be controlled by either elimination, reduction or prevention, such as eliminating a process; using another substance instead; using ventilation; and use of personal protective equipment (PPE). The workforce must be provided with adequate information and training on the risks, the safe use of substances, control measures, and provided with health monitoring where relevant. Use of PPE is important at J&B in controlling the affects of common hazards.

The initial study focused on the system in place to deal with the regulatory requirements. It focused on physical evidence on site for instance what could be seen on site, plus procedures and documentation used by employees to comply with the regulations. The study revealed that whilst information about hazardous substances is kept centrally, adequate information about these substances was not distributed adequately to those actually using the substances. It was concluded that whilst the information was available, it was not adequately communicated, and that employees appeared to be relatively unaware of the risks present. A detailed report was presented and action taken on the findings.

There was interest expressed by the company into finding out the true extent of knowledge, information and training, in relation to these regulations. In light of these findings, it seemed appropriate to conduct an awareness questionnaire to establish what level of awareness was present on site, to identify areas for improvement and prioritise them. From this an action plan would be developed and implemented to

complement the improved COSHH data information system that was also being developed.

3.2.2.2 Development of questionnaire

It was determined that a questionnaire would be able to establish what level of knowledge and awareness existed on site generally, and specifically in particular work areas. The more often employees were exposed to 'hazardous substances' the greater their understanding was expected to be. The questionnaire would aim to establish what training and information they had received, and what methods were seen as most effective for learning. The questionnaire also aimed to cover the use of PPE and training to use this in the workplace. Finally, it aimed to gather information on people's perceptions and awareness of the main risks in the workplace, other than and including COSHH risks.

Different methods of implementation were considered. A paper based questionnaire had the ability to cover all these aspects and allow people time to complete them either in their own time or in normal work time. It would be able to categorise answers, and remove the subjectivity that would be introduced by an interviewer. An interview style survey would limit the number of respondents that could be taken into the study, for logistical reasons. A structured interview would be too time consuming if it was to capture detail, but more importantly, would prevent collection of comparable information that could be analysed scientifically.

3.3.2.3 Design of the questionnaire

The questionnaire aimed, for the most part, to ask employees to make a positive choice between responses, and to remove for the most part, subjectivity on meaning of questions and therefore interpretation of responses. Plain language was used for the questions to avoid any difficulties with understanding and the options to be selected were designed to be simple and straightforward. It was determined that any respondent having difficulty in completing the questionnaire would likely fail to complete it, or respond with guesses, therefore removing the meaning from the overall result. One main problem with questionnaires of this type is that there is a

risk of positive acquiescence, i.e. that the respondent in doubt of the answer answers 'yes', therefore reducing the meaning of the final analysis. A questionnaire is at most risk of this if it is lengthy or vague, but this can be avoided by providing specific options, by avoiding having middle categories, and by keeping the questions brief and simple.

The following questions were presented in the questionnaire

1 Could you circle your department number on the list below ?

This question listed the department names. It aimed to capture information on the understanding of the Regulations by each department and the training they had received. This could be checked against the usage of hazardous substances in each department.

2 How long have you worked for J&B Scotland ?

The question aimed to check length of service with the company to see if there was a relationship between this and training received, and or understanding of the Regulations. It listed an option of 5 categories of service, aiming to capture relatively new employees, and those with short, medium and long service.

3 Which aspects of your job involve the handling or use of chemicals ?

This aimed to establish whether individuals were aware of the specific tasks within their departments or tasks that created contact with substances. For example, an individual when cleaning up, or performing maintenance tasks would almost certainly be exposed to substances, whether hazardous or not. This question aimed to establish if employees were aware of this exposure and when it occurs.

The question listed 6 options, with the addition of an option of 'other'. This aimed to be fairly flexible but ask employees to select positive choices.

4 Have you heard of the Control of Substances Hazardous to Health Regulations (COSHH) ?

The question is self explanatory, but as a result of positive acquiescence, it was expected that most people would answer 'yes' to this anyway. The employee was forced to make a choice between 'yes' and 'no' only. A second part to this question aimed to establish what the individuals understanding of the Regulations themselves actually was.

Could you tick any categories below that apply to the COSHH Regulations ?

A list of 5 categories were provided, where 1 option was the full answer, with another 3 categories being parts of the Regulations, and a final response a specific exclusion. It was determined that by responding positively to the 4 correct answers only, the employee showed good understanding. The question aimed to capture the respondent's perception of the Regulations, and for analysis 'yes' or 'no' responses applied to each option.

5 How frequently would you say that you handled or used chemicals in the course of your work ?

This question listed possible answers from never to more than one per hour per shift. On the basis that the more frequently they are used, the more understanding would be required, the questionnaire responses would be cross checked against departments. The closed question asked the respondent again to choose between 5 options, rather than leave it open to interpretation at the analysis stage.

6 What training has been given in relation to the safe handling and usage of chemicals in the workplace ?

All employees received information at the induction stage on COSHH Regulations, there was also information posted. The question aimed to check if this information had been understood as connected to hazardous chemicals in the workplace. Employees were given a number of options where they could select more than one type of training, and in addition the option of 'no training'.

Did your training lead to a formal qualification

A straight yes or no response would check those that had received certificates from courses that they had attended.

By what methods, other than actual training, have you been given information about the safe handling and usage of chemicals in the workplace ?

The question listed methods such as briefing, posters and videos to establish what other means the information had come across, if any. In some cases the employees may never have received this information, and this would be checked against departments. Employees were provided with 4 methods of communication, but were also given the option of listing another type.

7 How would you rate your level of understanding about the safe handling and use of chemicals at work ?

The options range from no understanding to excellent understanding, the respondent having to select one of the 6 options. There was no middle response to prevent a middle-of-the road response being given. It aimed to capture a definite choice. The option were written on a scale to make the range more visual. The question is intended to match the perceived understanding to the actual level of understanding. It would be evaluated against the frequency of use of chemicals and therefore if the employee has concern that he or she does not have enough information to perform the tasks.

8 What training have you received on the use of personal protective equipment in the workplace ?

The options vary from training in induction, on the job training and off the job training, aiming to capture what different types of training the individual has received. A range of 5 options were presented with a sixth of 'no training'. One of these choices was that of other to capture what techniques that respondents remembered being used for training. If the frequency of use of chemicals in the workplace is high, the individual should have received some training in the safe and correct use of personal protective training. The amount of training can also be evaluated against the individual's department, and the amount of service that they

have. Clearly, certain jobs, departments and tasks will have a greater need for PPE and awareness of safe chemicals handling than others.

Did your training lead to a formal qualification ?

A straight yes or no response aimed check those that had received certificates from courses that they had attended.

9 Which of the following methods do you feel are most effective for learning information in the workplace ?

This question requires the respondent to select three methods of providing information from a list of seven, and rank them in order of their effectiveness as learning tools. This question aims to capture the perceived preferred ways of being trained, and was intended to assess the most effective method of providing future training. It was also intended to be assessed against their perception of their own understanding of the regulations. The overall results would be collated to provide information for future training campaigns.

10 In terms of your job, what do you consider to be the main risks to yourself and your colleagues ? 'Risks' can include any risks that have occurred and any that can occur in areas of concern.

The respondents were asked to list three risks in order of significance in their workplace. This was the only open ended question in the questionnaire. A group of nine categories were built up on the basis of what answers were expected, and could be extended if these were proved insufficient. This question was intended to check a general awareness of risk in the workplace, and to understand if further awareness sessions were required on specific hazards. The risks were those significant to a specific workplace, and therefore were expected to vary from one respondent to another. This was to be evaluated against their area of work.

3.3.2.4 Implementation of survey

Pilot

After the design of the questionnaire was complete, a pilot group was selected to test the wording of questions and ease of response. The health and safety committee at the Blythswood site was selected as the pilot group. The researcher was present in the room at the time, to capture comments on the survey content and format. After these comments had been considered, improvements in wording were made to the original questionnaire.

Full study

The actual questionnaire was launched at the Strathleven site in September 1994. It was distributed in two main ways, first by issue to the health and safety committee and second, by handing copies to line managers on site for distribution to their employees. The purpose of the questionnaire was explained to those members of the safety committee that had not previously been involved, and their support requested in encouraging their work colleagues to complete the survey.

The rest of the work force were provided copies of the questionnaire by their line manager or team leader with a front page explaining the purpose of the questionnaire and return details.

3.3.2.5 Results of questionnaire :

The analysis of the COSHH (Control of Substances Hazardous to Health) survey questionnaire was to determine correlation between the sets of data that has been collected.

There were 54 simple random samples returned from a population size of 500 on the site. The 20 different departments were grouped into 5 subsections according to exposure to chemicals and hazardous substances :Engineering and maintenance, General site, Office and development, Spirit handling, Production.

Statistical procedures used

Most of the statistical procedures require assumptions about the populations from which the samples are selected. For example, in the two-sample t-test, we have to assume that the data are from populations that have normal distributions, or that the sample sizes are large enough so that the distribution of sample mean is normal. To use a "pooled" t-test, we also have to assume that, in the population, the two variances are equal. Procedures that require assumptions about the shapes of the distributions from which data originate are known as parametric procedures. Many parametric procedures depend on the assumption of 'normality'.

To analyse the COSHH dataset, however, the assumption of normality does not appear reasonable, since the sample size was quite small and there is little information about the distribution of the data. In addition, interval data may originate from markedly non-normal distributions (positive or negative skew). In those situations, procedures that require very limited assumptions about the distribution of the data can be used. Collectively, these procedures are called non-parametric tests.

The advantage of non-parametric tests is, that they require few assumptions about the data. However, the disadvantage of non-parametric tests, is that they are usually less powerful than parametric tests at finding differences between groups or variables when the differences do in fact exist. They usually ignore some of the available information, for example: they replace actual data values with ranks. By losing the actual values of the data, ranking does not provide information about the distance between the ranks -whether very small or very large. The only information we have after ranking is that they are one level higher or one level lower. In general, if the assumptions of a parametric procedure can be met, the parametric procedure should be used. It is common but incorrect for parametric analysis to be performed when such assumptions are not valid.

For this dataset non-parametric sets are favoured because of the respondent sample size and the sparsity within Departments. In addition because many of the variables are in terms of sets of ordered categories (ranking data) such as an understanding

level of nil, poor, adequate, fair, good, and excellent, the results cannot be given any precise numerical value. This too is a common fault in 'amateur' surveys where false numerical accuracy is sought and given as if the numbers themselves have some power. Although ranking does not provide information about the distance between the ranks, many properties are measured that cannot in any event be given any precise numerical value.

Following are several procedures that were used to analyse the dataset.

The Mann-Whitney test

The Mann-Whitney test, also known as the Wilcoxon test, can be used to test the hypothesis that two independent samples come from populations having the same distribution. The type of distribution does not require to be specified. The test requires only that the observations are a random sample and that values can ordered from smallest to largest. Normality and equality-of-variance assumptions are not needed. The hypotheses tested by the Mann-Whitney test are shown below:

Null hypothesis : The mean of two groups are same

Alternative hypothesis : The mean of two groups are different

The Kruskal-Wallis Test

The Kruskal-Wallis test may be used to test for a difference in the means of several samples (groups). The two basic assumptions are : (i) experimental units are assigned to the samples at random; and (ii) the responses in each sample have a symmetrical distribution and only differ, if at all, in their medians or means. If the distribution of error is markedly asymmetric, the safest test is the *median test,* this can be inspected by creating a histogram.

The Chi-square statistic and Fisher's exact Test

The chi-square statistics are useful for measuring the strength and nature of associations when the two variables are *categorical***.** These variables have a limited number of possible values, and their distribution can be examined with a cross-tabulation table.

The chi-square test hypotheses are:

H_0 : The two variables (row and column) are associated with each other.

H_1 : The two variables are independent.

If some of the expected values in a two-way table are less than 5, the observed significance level based on the chi-square distribution may not be accurate. In general, the chi-square test should not be used if more than 20% of the cells have expected values less than 5. In addition, none of the expected values are less than 1.

If any of the expected values in a table with just two rows and two columns is less than 5, an additional test called Fisher's exact test may be performed. This tests the same hypotheses as the chi-square test, and is most useful when the total sample size and the expected values are small. It can, for example, be used to test the association between "heard about COSHH regulations and training received".

3.3.2.6 Data analysis and commentary

There were 54 simple random samples returned from a population size of approximately 500 employees.

1 Perception/ Awareness Tests v Training

A test was carried out to test employee perception of their understanding of the safe use of chemicals against the training received. The test showed that *perceived* understanding of safe handling and use of chemicals in workplace is significantly associated with training received. From the value of the mean rank, we can see that people from the trained group are more confident of understanding the safe use of chemicals than people who are untrained.

No employees responded that they had nil or poor understanding in the trained group; but 41% of people in the untrained group said they had nil or poor understanding of the safe use of chemicals and hazardous substances. When this was checked against their 'knowledge' it was found that 25% of employees that had

received training scored full marks in the knowledge test, yet in comparison only 3% of those who had not received training scored full marks.

2 Knowledge Tests

A knowledge test was carried out to test employee knowledge of the COSHH Regulations against the training they had received. The results showed that no employee who had received training achieved less than 50% in the COSHH regulations test. Only one out of 37 (3%) employee from the untrained group got full marks compared with 3 out of 12 in the trained group (25%), figures that suggest that people who had received training are more likely to get a higher score in this test of knowledge. A Mann-Whitney test finds that the significance p-value is less than 0.01. That is, that the mean of the two groups is different at a confidence level of 1% or better - we would only expect this to happen by chance in one case in 100. Thus, there is evidence that there is a significant association between the variables of training received and results obtained in the test. As the mean rank of trained group is higher than the mean rank of untrained group, it means that trained employees are more likely to score higher marks for knowledge.

By the same procedure, we can check whether different kinds of training would affect the results of COSHH regulation test. From this, all p-values are greater than 0.05. That means that the use of different training methods does not affect the knowledge of the COSHH Regulations test results at the 5% level - a commonly used cut-off. Thus, it is the fact that training has been received, rather than the type of training, that influences the variable.

In order to check whether employees who had received training had heard of COSHH, i.e. they are correlated to each other, the chi-square test was used.

Analysis shows that all trained employees had heard of the COSHH Regulations, and that 36% of untrained employees had not heard of the Regulations. The test result shows the association between employees who had received training *and* heard about

the COSHH is significant at 5 %, confirming the result of the test knowledge against training.

A test was performed to see if there was a difference in knowledge about the COSHH Regulations across different departments. Significant differences were found. The results suggested that the engineering and maintenance departments had the best understanding of the regulations compared to other departments. The production department had the poorest knowledge of the regulations, and it should be noted that a high number of chemicals are used in this area.

The statistical test results in this section suggested that the training given was useful for providing understanding of the COSHH regulations. This was not affected by the method by which the training was provided : on the job, off the job or during induction.

The test also showed that employees who frequently use chemicals were more likely to be trained, as would be expected. Another reason however, might be since the people had been trained, they then understand that what they are using are, in fact chemicals. This is a base problem with all such assessments.

3 Effective methods for learning information

The order in which employees selected methods for learning information are shown below, in order of effectiveness :

1 On the job training
2 Off the job training
3 Video session
4 Briefing sessions
5 Posters
6 Leaflets/Bulletins

Most effective method of learning by department

There are five samples (departments) for testing a difference in the means, therefore we can use the Kruskal-Wallis test (one way analysis of variance). If there are only two samples, the Kruskal-Wallis test is equivalent to the Mann-Whitney test.

The 'preference' for three of the methods is different for different departments. They are (i)off the job training, (ii)briefing sessions and (iii)posters. All of them are significant at 5%. The remaining methods do not appear to be different in preference for employees across different departments.

From the output of the mean rank values, we can see which department most prefers certain methods. The results are shown below (in order) :

Off the job training

1 Engineer & maintenance *

2 Spirit

3 Production line / Office and management

4 General site

Briefing sessions

1 Office and management / Production line *

2 Engineer & maintenance / General site

3 Spirit

Poster

1 Spirit *

2 Engineer & maintenance

3 Production line / Office and management / General site

A further test was carried out to assess if there was a link between number of years experience and training. We can see that people in the trained group had worked for a significantly shorter period of time than the untrained group. People with less than

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* significantly regarded as an effective method

15 years service had a greater understanding of chemical handling, and demonstrated better test results than people who had worked for over 15 years. However, the number of years service did not appear to affect whether the employee had heard about the COSHH regulations or not.

These results suggest that attention should be paid to retraining and refresher courses - employees with longer service may have received the information before and then forgotten it, or may not have received it in the first place.

4 Perception of main risks on site v Department

The following list resulted from the question 'what main risks concern you?', it is listed in order of concern.

1 Chemical
2 Slip and Fall
3 Machinery
4 Fire and explosion
5 Kinetic / Vehicles
6 VDU
7 Smoking

A test was carried out to assess if there is a relationship between an employee perceiving chemicals as the highest risk and training received on the COSHH Regulations. It is interesting to note that people who had training were more likely to perceive chemicals as the highest risk. Perhaps the additional insight into chemicals as a hazard increased an awareness that was not matched by training in other relatively more significant risks. Alternatively, those responding that chemical risk was highest may also handle chemicals frequently as part of their job, and have responded with their perceived personal exposure.

On this basis, a further test aimed to evaluate if different risks were rated as the 'main' threat by employees of different departments. The charts shows that most employees working in the group 'general site' regarded chemicals as the highest risk - this category includes cleaners and the security team. Most of people working in

production correctly perceived slips and falls as the main risk. Finally, engineers and maintenance workers regarded machinery as the highest risk. Therefore, the link between experience of risk in their individual work context and their perception of main risks is very clear.

3.3.2.7 Summary / conclusion of survey

Survey results indicated that all training given contributed positively to the understanding of the COSHH regulations. It also showed that employees were more likely to be trained if they use obviously hazardous chemicals frequently. It is interesting to note however that, technically, all employees on site (outwith office areas) deal with chemicals, whether the product itself (alcohol/ ethanol), cleaning chemicals, glues, inks, or oil. Therefore, employees who had received training may respond better in the survey as they understand that what others may overlook, are actually chemicals too.

The knowledge test suggested significant differences between departments, it suggests that the engineering and maintenance departments have the best understanding of the regulations and the production department has the poorest knowledge of the regulations. Both departments are exposed to chemicals on an equal basis, but with the engineering department having a slightly more hands-on approach. This suggested that there is a serious deficiency of knowledge in the production areas over the exposure to, and safe handling of chemicals.

The survey provided useful information on the methods of training which employees prefer. Overall, the study group preferred (in order) : on the job training; off the job training; videos; briefing sessions; posters and finally leaflets. This information can help shape future training/ information campaigns. As there appears to be no significant difference in the knowledge gained between different training methods, it would be preferable to select training methods to which employees can relate.

It appeared that all employees had heard of the regulations but those with a shorter service history had more detailed knowledge than those who had worked for a longer

period. This suggests that perhaps induction training is effective in providing information, but also that there is a strong case for refresher training.

When asked for the main risks on site to be listed, it appears that all individuals have listed risks *in their own experience* as the main risks on site, e.g. engineers listed machinery, cleaners listed chemicals, and operators in production listed slips, trips and falls. Overall the four main risks listed were chemicals, slips, machinery and fire in that order. It is possible that because the survey focused specifically on chemicals, it skewed employees responses to list this as the highest risk. Factually, the most frequent causes of accidents on site are slips, trips and falls, and cuts, and the main serious risk is fire. Both of these categories can affect all employees on site.

It is interesting to note that people who had training are more likely to regard chemicals as the highest risk. Perhaps the additional insight into chemicals as a hazard, increased an awareness that was not matched by training in other risks. Alternatively, those responding that chemical risk was highest may also handle chemicals frequently as part of their job.

Some general points can be made by this study. The question as to whether training produces knowledge, or whether training is given to those who work with chemicals and have knowledge is a common one - chicken and egg. The expressed preferences for training methods also point to a common difficulty - respondents clearly prefer certain methods, but there is no internal evidence on efficacy. External studies, carefully controlled to remove bias, must then be accessed to find the most (cost) effective method.

3.3.2.8 Summary of the utility of the technique itself

A survey questionnaire in this format is limited in usefulness in a number of ways. First, the responses that one receives and their accuracy is directly influenced by how well the questions are written. If the questions are confusing, difficult to interpret or contradictory, then the answers will be the same. This can be minimised by making the questionnaire as simple as possible, and by providing answers to be

selected. Although useful information can be obtained by leaving a question open, it is difficult to interpret and analyse overall. The response is also then open to the subjectivity of the analyst.

Questionnaires can help to capture attitude and awareness of specific issues, but cannot predict behaviour. They are a useful tool with which to evaluate a change in awareness and perception over time. They can also be useful in checking whether training has had an impact on awareness and knowledge of a specific issue. As discussed in Section 4.1, it is unwise to infer behaviour from expressed attitude or even from recorded awareness. This is probably one of the most frustrating aspects of safety management - there is no reliable or common sense link between attitude and resultant behaviour. Perhaps the only thing we can rely on arising from awareness of risk is the knowledge that you are doing something silly as you do it.

A survey in this format has most value in capturing the levels of awareness and knowledge of a specific issue. The survey can then be repeated after a set interval, perhaps after a training programme or after a 1 year period, to identify any changes over time, but this raises the question of how to sample - the same people or a new random sample. It can also be used to identify problem areas - in this case the production based employees appear to have very little knowledge and awareness of the Regulations - and from this information implement targeted improvement plans.

3.3.3 STRUCTURED INTERVIEWS

As an alternative to the written questionnaire, a structured interview study was conducted in January 1996. A set of key questions were posed to a broad cross-section of around 20 Managers, Supervisors and Safety Representatives across all 7 sites. The interviews were not intended to cover the opinions and attitudes of all employees, only to capture a snapshot of a cross-section of employees. Therefore, specific individuals were selected rather than randomly selected from the work-force. Several methods of data collection were considered before the decision was taken to use personal interviews.

3.3.4 CASE STUDY 2 : PERSONAL INTERVIEW STUDY

A personal interview survey has advantages against a paper questionnaire when there are certain outcomes required from the survey. Firstly, and most importantly, the interviewer has the opportunity to discuss complex questions and to follow up answers. It enables the interviewer to get to the base of an issue, and capture the answer for that respondent. This type of questioning cannot be simulated in a paper questionnaire. Difficult concepts can be explained by the interviewer, and the answers given can be readily followed up in further interviews if required. Such information and leads would not be so readily available through other mediums. Each individual respondent may be more or less likely to be forthcoming and honest in a one to one dialogue. Many different mediums can be used by the interviewer to illustrate his or her point or line of questioning allowing technical questions to be included in the survey where required. It is also possible to capture a greater amount of time and attention from a respondent in a face to face interview than through a self-administered questionnaire. Common difficulties with paper questionnaires (especially lengthy or vague ones) such as positive acquiescence, can be avoided more readily by a personal interview.

There are, however, many disadvantages to this type of survey. Probably the greatest disadvantage of the survey style is that the responses given, and even the way in which questions are asked are open to interpretation, therefore there can be inconsistencies in the survey response. It is also very time consuming for the interviewer to arrange interviews at mutual times, and to perform them for all respondents. In addition, significant follow-up time is required after each interview. If an external resource is used for such a survey, it is liable to be costly, but this has to balanced against the skills required in-house. In addition, the interviewees have to be comfortable that they can answer fully, honestly, without prejudice and with assurance of total confidentiality.

Telephone interviews could have been used to conduct the surveys but would have removed all the advantages of face to face rapport in an interview. In addition, it did not seem appropriate to carry out this style of interviewing within a company.

Because of the nature of the questioning and the intended capture of personal (and perhaps controversial) views, it was not appropriate to use group interviews either. In all, the use of personal interviews, albeit time consuming, was selected as the most appropriate method for the scope of the survey.

For this reason, the survey was carried out on small target groups only, most of whom had been interviewed in a survey in 1993, carried out by Strathclyde University. The replacements for those individuals who had left the company since the original survey were generally interviewed. Additional individuals were also selected as their views were of interest to the survey, the most significant of those being the safety co-ordinators and site safety advisors. These individuals had been put in place in the interim period of time.

The same interviewer was used for all interviews to ensure that there was consistent style in questioning and interpretation. All interviews were recorded to avoid future misunderstandings, and to allow the interviewer to focus on the interview itself, not writing down answers. A period of approximately 1-1½ hours was allocated for each interview, with additional time scoped in for key interviews.

The interviews aimed to determine attitude and change of attitude towards safety management over a three year period. These questions aimed to establish : if and why the managers' had changed their personal attitude to safety over this period ; if and why the company had changed it's attitude over time ; and the perceived main risk exposures that existed. The structured questions are listed on page 106 of this section.

At Executive level the following spread of individuals participated in the interview study : Managing Director; Operations Director; Quality Director and Site Directors (Blythswood, Distilleries). They were selected as they had overall functional responsibility for safety, or a had a large number of people reporting to them that were affected by safety issues. At Management level - site Production Manager, Team leader/Line Managers, Site Safety advisor, Risk Manager, Strathleven safety

co-ordinators, safety representatives, supervisors. The Production Manager and supervisors were chosen due to their responsibility for people, the others were selected as they had a particular role for safety on their site.

3.3.4.1 Structured interview questions

The main objective of the interview study was to establish the awareness of and commitment to safety from key individuals influential within the business. A comparison with the study results three years earlier would be performed to determine if there was any change, positive or negative. Another key reason was to establish that, with the many changes of personnel, the commitment to safety improvement that had been previously indicated, been carried on by the new team.

The survey aimed to establish the key turning points within the company, whether internal or external pressure, for example : court cases, or specific campaigns or incidents. This information could then be used positively, where appropriate, to improve awareness and commitment again.

It was recognised that while the survey can cover a range of topics, the main pitfall is that the respondent answered with 'what the interviewer wants to hear'. The survey aimed to ask specific questions to ensure that responses given were validated. In addition, leading questions were avoided at all times.

Safety Awareness and Commitment

Structured Interview Study – Questions January 1996

1 What are your current position and main responsibilities in the organisation in 1996 ?

2 What has been your personal history since joining the company - and what were your position and responsibilities in 1993 ?

3 What was your personal attitude towards safety in 1993 ? And why did you have this attitude ?

4 In your opinion, what was the company's 'attitude' to safety in 1993 ? What was the safety culture ?

5 How has the company changed it's safety culture, if at all between 1993 and 1996 ?

6 What has changed - what are the main factors or reasons for this change ?

7 How has your own attitude changed in these 3 years if at all, and what are the reasons for this ?

8 What is your attitude to safety as an individual now ?

9 How has the emphasis on safety within the company changed, and has it changed for better or worse in your opinion?

10 What systems are in play to manage safety?

11 Where do you feel the company is exposed - what do you see as the main problem areas or deficiencies in safety management? What keeps you asleep at night?

12 Where do you feel exposed as an individual and/or as a manager in relation to exposures in your area of responsibility ?

13 In light of recent prosecutions in Corporate Manslaughter cases, what affect has this had on your thinking in relation to personal responsibilities ?

14 What effect, if any, does the CHASE Audit have ?

15 What are your views on the use of disciplinary action to enforce safety standards ?

16 What percentage of injury and non-injury accidents do you think are reported on site ?

17 What effect do you think the Safety Management system will have, if any, on safety standards ?

18 Have you any suggestions or ideas for improvement of safety management within J&B Scotland ?

19 Have you any other comments that you would like to make in relation to this interview ?

3.3.4.2 Summary of findings from interview study

Individuals from both the Blythswood site and Strathleven were interviewed. Several of the respondents had company wide responsibility.

Combined Results

The following general main findings were raised by respondents across both sites.

1 The fatality and a few other serious accidents made the company and management team sit up and pay attention to safety issues on sites.

2 As a driver, the CHASE audit system has had a significant impact on health and safety by providing focus and co-ordination of company goals.

3 There were no formal systems in 1993, there is now a more systematic approach

4 The real focus is on production, safety is taken seriously but resources are not put into safety, such as the writing of safe systems of work, or training of the management team.

5 Initiatives that are started with the best intention are often suspended due to other 'priorities'.

6 Commitment from management needs to be demonstrated in action rather than just words.

7 Genuine support in terms of resource is required rather than expecting limited number of people to take on more and more.

Blythswood

The following comments were made by respondents at Blythswood on the evidence that they have seen of changes on site in the 3 year period.

1 The site safety co-ordinator with specific responsibility for safety has increased focus and profile of safety on site (agreed by all interviewees). There is now support available on site, it is now more accessible than a central resource visiting from Strathleven.

2 Further cultural change can be achieved by discipline against safety breaches.

3 Some operators still have a belief that supervisors are paid ‘extra’ to take responsibility for safety.

4 The main indications of increased safety commitment by management are seen as : the CHASE Audit, Risk Assessments, Operator Training Group, "more focus on health and safety in last 3 years than on most things", but health and safety is now bogged down in a paper chase.

5 Company and site direction on health and safety comes from Strathleven, the Blythswood team would like more involvement at strategic level.

6 The company is sincere about health and safety and relevant training, but do not resource it with people - either to carry out additional tasks, or provide cover for health and safety training and activities.

7 "All accidents are reported" commented one supervisor, stating that this is because the site safety co-ordinator requires investigations to be carried out on the same day. As a contrast, a warehouseman stated that the company will "never get 100% reporting, especially for minor and property damage accidents".

8 Some tasks on site have inherent risks which are manual related and difficult to remove.

9 Initiatives that are started with the best intention are often suspended due to other 'priorities'. The example given was the Operator Training Group, written safe systems of work and performance of Risk Assessments on site.

10 Disciplinary action is more common now than 3 years ago against safety breaches.

11 The company seems fairly serious about safety.

12 The company shows increased commitment to safety

<u>Strathleven</u>

These comments were made by a cross section of employees at Strathleven, they were picked out as common threads.

1 The most significant driver for the improvement of safety standards in the last 3 years has been the introduction of safety co-ordinators.

2 Several serious accidents have had significant impact on behaviour as managers. Realisation that it *can* happen to you.

3 The CHASE audit has provided the impetus for continuous improvement of safety standards on site.

4 A portion of the management bonus being based on performance in the CHASE audit has helped to focus the management team.

3.3.4.3 Critique of the personal interview study

The management/ employee personal interview study had several benefits to J&B. It provided a view of the changes in safety standards, systems, commitment through the eyes of different levels of employee. This can then be checked against those responses given in a previous study, perhaps three years before. Many safety campaigns, systems or programs take as much as three years to implement, and perhaps longer before results, if any, are visible. An interview study helps provide a longer term view where people are asked to compare the past to the present and identify differences.

Therein lies the difficulty as people are asked for their opinions which may not be representative of all employees. The aim was to pick a cross section of employees from Executive level to safety rep who could be asked say in 1993 and then again in 1996. This can prove difficult if there is a high turn over of staff on a site (Strathleven) or within a company as a whole, as no consistency with which to benchmark can be achieved.

An interview study would have no great return if repeated say annually, it has its greatest benefit as a benchmarking exercise over longer periods of time. As discussed earlier, there is much doubt whether there is a link between attitude and behaviour, but this study aims to capture changing levels of understanding, communication and awareness. It focuses on the actual *changes* within a company over time and aims to identify what has worked, what has not worked.

The findings of this study were useful, and reinforced what the research had suggested. Many of the remarks also echoed the thoughts of the external auditor and his beliefs of what the progressions were and why. It was useful to know that whilst senior managers felt committed to the improvement of health and safety, supervisor and employees felt that their commitment was mainly in words not action and required greater demonstrated commitment. One of the greatest criticism was the lack of resource and the constant change of initiatives which had been visible to the researcher, if not to Senior Management.

3.3.4.4 Summary of the structured interview as a technique

Any study should set out to capture information about levels of safety awareness or knowledge for it to be of any practical value at all. It is suggested that an 'awareness' study that focuses on the knowledge and understanding of very specific issues will be more indicative of actual behaviour than those on more general issues.

An awareness study, perhaps by questionnaire, may be useful for the identification of training or information needs for the study group and it may also suggest reasons why accidents of a particular type have been repeated in an area. It is not, however, an accurate or scientific guide to health and safety *performance*. The study must be carefully designed so as to avoid providing meaningless or misleading information, or confusion for the respondent and the method of data analysis must be carefully considered beforehand to avoid non-causal correlation's such as 'the awareness of the need for hearing protection has increased with paper consumption on site'. Issues of interpretation of such studies require expertise in design, performance and analysis of an awareness study. Expertise that may not be available within a company. The performance of a study will require the availability and time of all participating individuals.

It is suggested then, that a specific awareness study, by personal interview, may be worthwhile if it is expertly carried out on a 3-5 yearly basis. It should be used as a bench marking exercise only, rather than a true measure of health and safety performance. The key is that common issues raised by respondents in the interviews are followed up to seek specific improvements in performance. An interview study is useful when used as a benchmark over time.

3.3.5 COMPARISON OF METHODS AND UTILITY

To determine which technique to use, the following factors should be considered :

1. What information do you wish to collect
2. Is this information complex or threatening, will the questionnaire be lengthy
3. How much finance is available to fund the survey
4. What is the geographical spread of the respondents

5. Do you need background or environmental characteristics
6. What special circumstances exist

If the information that one wishes to collect is complex or detailed, a one to one or a telephone interview would be the most effective techniques – in both cases the interviewer can explain each question, and probe for further information. Paper questionnaires cannot explain complex concepts behind questions, and therefore they can only address simple self-explanatory questions effectively. However, if the information is sensitive, it may be more effective to collect it by a mail questionnaire where the respondent feels that he or she has complete anonymity.

The most expensive method of collecting information is the one to one interview, it is also the most time consuming for the interviewer, and most difficult to arrange logistically. As a contrast, the mail questionnaire is least expensive to implement, but has the disadvantage of a lower response rate, the telephone interview provides the middle ground. For the same reasons, the geographical spread of the respondents will influence the method of survey – if there is a large spread in the survey group, one to one interviews will not be cost effective, and mail or paper questionnaires will be most practical and cost effective. If respondents are clustered, for example on several company sites, personal interviews may be viable, but the number of people to be interviewed would influence whether this is practical or not.

Another factor to consider is whether an individuals background circumstances need to be evaluated, whether this is their working or home environment. In many cases this will not be relevant to a occupational based questionnaire, but where it is, the survey will have to be conducted in that environment to enable the interviewer to evaluate it. This in turn would require the survey to be carried out via a personal interview which has it's disadvantages in terms of cost and time, as mentioned earlier.

Finally, other factors need to be considered to ensure that the survey is successful and provides the right type and volume of information. These factors would include

commencing the survey at the right time avoiding holiday and shutdown periods and peak production where applicable, and having the required management support to ensure an adequate response rate. Another critical factor in the success of a survey is the route for the return of the responses if it is a mail/paper questionnaire. A route must be established that provides the respondent with assurance of confidentiality, and that does not require much effort. In an occupational safety questionnaire, the questionnaire could be returned directly to the Safety Department or via Safety Representatives, rather than through the Line Manager. In addition, there must be an awareness of all external factors that can directly influence the responses given, and whether this gives an accurate picture or not. For example, factors can include downsizing, restructure, merger, time of year, seasonal fluctuations in production. The survey can then be conducted (or postponed) with this knowledge in mind.

The optimum survey method then depends upon what type of information you aim to collect, from whom and how. In general, the personal interview is most appropriate for the collection of detailed information from a smaller group of individuals, where a high response rate is required and the time pressure to complete the interviews is not as high. As a contrast, the paper questionnaire is ideal to collect simple information for a large number of respondents over a geographically large area, at relatively low cost. However the negative side is that the response rate may not be as high, and it may take a long period of time for responses to be returned, but this part of the process can be managed by implementing a follow up process.

3.4 COST OF ACCIDENTS STUDY

3.4.1 OBJECTIVES

Accidental loss has a direct impact on the profitability and efficiency of an organisation, affecting employees, customers, the company and society at large. As Drucker stated " the first duty of business is to survive and the guiding principle of business economics is not maximisation of profit, rather it is the avoidance of loss". The process of measurement and analysis of the cost of financial and opportunity costs to a company through accidental loss does not directly reduce the number of

accidents that occur. However, such a focus allows a clearer understanding of the nature of accidents, their spread, cost and type, and from this understanding, more effective safety decisions can be made. Risk can be avoided or reduced to the lowest cost effective level if actual cumulative costs are known.

The study aimed to,

i) Evaluate patterns of loss within the company and to identify if there were deficiencies in the safety management system that could be cost-effectively improved.

ii) Evaluate the effectiveness of the risk financing arrangements and to make recommendations for improvement where it was required.

iii) Determine an average cost of accident per 'class', to enable projections of future loss to be made and thus determine the annual cost of risk to the company.

iv) Develop, if possible, a *general purpose* costing tool that could be applied at least within the drinks industry and, perhaps, more widely.

3.4.2 BACKGROUND TO THE STUDY

The Health and Safety Executive carried out a study into the cost of accidents in 5 organisations in the UK in the period 1990/1991 (HSE, 1993). The study was carried out using research teams from the HSE who developed a methodology that aimed to capture accurately the total cost of injury and non-injury accidents to the selected organisations during the period of the study. A study was implemented in each of the organisations lasting 13-18 weeks.

There were limitations placed upon the HSE Cost of Accidents study, firstly although *all* identified injury accidents were included in the study, only property damage incidents above a specified minimum level were included. This minimum level was set at a minimum unit of production or its financial equivalent. Below this level the concentrated observation methods used were determined to be an inefficient use of resource.

The study team also restricted the study to capture data on losses that were economic and within the control of the participating organisations to prevent. The study was further limited to those losses that were directly borne by the organisation, that is, it excluded insurable costs.

The HSE study was performed by the development of data collection forms for dissemination to the work force for capture of cost information. There were initial discussions held to agree the overall objectives of the study and the most effective method of data collection using the specific reporting structures within the organisations. Four data collection forms were designed for the study:

Form 1 Departmental Accident Form - for completion by the Department where the accident occurred and collects data on all costs arising from that accident.

Form 2 Secondary Stage Form - for capture of costs to other Departments from the occurrence of the accident.

Form 3 Continuing Costs Form - for completion on a weekly basis by each Department on long term absentees and replacement labour costs on an ongoing basis.

Form 4 Management Report - a weekly report for completion by management on personal involvement and that of administrative staff in accident investigation.

The study to cost accidents was then carried out by HSE research team using methodology briefings and concentrated observation in each of the organisations. The data were collected, evaluated and the results published. Various recommendations were published along with the results of the research. Firstly, the HSE considered the method that they used to be suitable for reproduction by other UK companies of small to medium size, where there was a suitable sample size upon which to base conclusions about overall costs. Secondly, the HSE recognised that, because their study aimed to collect one hundred percent of accident costs in the study period, it was, therefore, *very* resource intensive. It was acknowledged that

this would not be practical or even desirable for companies with limited resources to attempt. There was a suggestion that modification of the original study for an individual company's culture, reporting structure and resources would be appropriate.

At this time an accident costing study was being developed in J&B and the publication of the HSE work lead to contact and meetings between the J&B study group and the HSE. HSE were encouraging other companies to use their method of costing accidents or to modify it for their own circumstances an/d requirements as outlined above. This encouraged the tailoring of the prototype system at J&B to follow where possible the HSE format, but to remove certain idiosyncrasies from the methodology. The intensity of observation and the expertise that the HSE study required were clear negatives. In addition, it was judged that a short intensive study would fail to capture any seasonal effects and variations. Seasonal effects on accidents are likely to exist in any organisation with fluctuating production rates and, therefore, a longer period of study is required. For J&B this implied a study to be performed over a period of at least one year.

The observational intensity required by the HSE study could not be matched, in addition it was appropriate to develop a system that could continue to be used. This suggested a simplified reporting scheme should be used, at risk of missing some financial data. This system should be 'truthed', by a detailed study of a limited number of events.

In summary, therefore, J&B (and by implication most of industry) required a continuous method of costing that required little specialist resource and did not add to the losses that had already been incurred in the incident being studied. Resources are always limited. There is a practical need to balance the cost of investigation against the losses involved and learning from incidents cannot take priority over making improvements to the safety systems.

3.4.3 WHY DO A COST OF ACCIDENTS STUDY?

As an essential part of a Process Maturity model (Paulk, 1995), a Cost of Accidents study can be used as a bench mark to position the performance of the company at any time. The study was expected to show the cost of risk to the company in a period of a year. It would demonstrate how far the company had moved in terms of reducing accidental loss and related costs, and the distance still to be travelled in the quest for 'total safety'. The study would not improve safety in its own right, but it was intended to facilitate such an improvement. The information gained from the study was also intended to help reduce accidental loss, by providing a baseline upon which improvements could be identified and implemented.

The study also intended to highlight problem areas within the company, so that changes could be made. It aimed to analyse accidental loss: the length of absences related to accidents, repeated accidents and accident black spots within the workplace. Control measures could be identified to resolve key problem areas, and they must be cost-effective. The study aimed to provide information with which cost-benefit analysis could be carried out. The control measures and accident experience were to be measured against the risk financing arrangements, to ensure that the most effective cover was in place. The study would then enable the risk financing arrangements to be optimised.

The study aimed to determine average costs of accidents, and produce average costs per *class* of accident. The initial benchmark costs could then be used as multipliers in futuristic studies, without requiring human resource and administration costs each time. It is known that accidental loss has higher costs than the amount that is claimed from an insurance company. For a start, many costs relating to accidents are not claimed from insurers, and in some cases *cannot* be collected. The study intended to determine what the ratio of insured loss against uninsured loss actually is, in the period of study. Another aim of the study was to identify any relationships and ratios between severe injury accidents (e.g. reportables) and non serious injury accidents (e.g first aid treatment only injuries).

Although, not a primary reason for performing the study, it should be noted that, the impact of an accident, is not only felt by the company that suffers loss, but also various external parties outlined briefly below. Many of these costs are intangible to a large extent and are felt to be outwith the remit of a company, but not outwith a social conscience.

3.4.3.1 Individuals and dependants

There will be an adverse impact on the individual and his dependants as a result of an injury accident. Either in short or long term there will be a loss of earnings of the individual, perhaps due to a loss of overtime or bonuses that would otherwise be paid, or perhaps due to a reduced level of pay when there has been a long period of absence. There may be an increased cost of living due to additional expenditure on heating, purchase of medicines, hospital attendance and other rehabilitation methods. Perhaps there will be a loss of amenity due to permanent incapacity which will have a severe impact on the quality of that individuals life, and that of his or her dependants, this reduced quality of life has its own costs. The worry and grief of the dependants, family and friends also reduced their quality of life and welfare. As a result of an accident an individual may face the risk of unemployment and so, the risk of long term debt, homelessness and poverty is increased. Individuals who suffer serious accidents, and those who witness them are also at risk from Post-traumatic shock syndrome, with the potential of long term mental health problems and an inability to carry out a normal life, irrespective of the extent of their injuries.

3.4.3.1 Society and the economy

In the event of an accident, there are costs to society as a whole and the economy is also adversely affected. The cost of absence due to occupational injury is said to cost employers £400m per annum (Davies, 1994). It is known that 18m days are lost in the UK per annum due to injuries at work. It is estimated that the total cost of work accidents to employers in the UK per annum is between £3823m and £8711m. The costs to society and the economy could otherwise be redistributed for a more positive purpose such as improving health standards and developmental work.

When an individual has an accident, he or she will be paid social security compensation, and will be treated under the National Health Service. These costs are paid, in effect, by the rest of society to the individual via taxation and National Insurance contributions. Under the principles of all insurance, the losses of the few are borne by the majority. As a result of an accident, society has lost valuable resources in terms of materials, labour, services, and capital that would otherwise be utilised within the economy. The economy will lose the service and contribution of victims of fatal and major industrial accidents. An investment has been placed in each individual within a society such that a major or fatal accident will result in the loss of experience, expertise and the cost of the education of that individual. There will be a loss of welfare of society due to the pain, suffering and grief of that individual, or his relatives due to injury or premature death.

Premature death will also cause a major change to the financial and social circumstances enjoyed by dependants. The costs of accidents at work; in particular those that are uninsured will be seen as operating costs by a company. The cost of these accidents will be passed back into society via the consumer in form of a price increase. Therefore the loss will be borne by society twice, both from the product and secondly, under the National Insurance system.

3.4.3.3 Customers and suppliers

The cost of accidents will also have impact upon customers and suppliers. A supplier will be required to quote minimum prices if a company is trying to reduce its costs. Particularly on products with low unit costs, the price of an accident will have a large impact on the efficiency of an operation. Customers will be adversely affected by the cost of accidents, as orders are late or incomplete, causing the customer to fail to meet his own obligations and contracts to supply.

3.4.4 DEFINITION OF TERMINOLOGY

The terminology used by the Health and Safety Executive was also used in the J&B Scotland study with the exception of the classification of accidents.

Accident

The term 'accident' refers to any unplanned event that results in injury or ill health of people, or damage or loss to property, plant, materials or the environment, or a loss of business opportunity.

First Aid injury accident

An unplanned event that leads to an injury that requires first aid treatment but no other time is lost from the normal place of work.

Minor injury accident (with no associated lost time)

An unplanned event that leads to an injury where there is less than one shift lost from normal work. Requires treatment from a first aider or occupational nurse.

Lost time injury accident

An unplanned event that leads to an injury which results in the injured party losing more than one shift but less than four days from his or her normal place of work.

Reportable accident (injury)

An unplanned event that leads to an injury which results in the injured party losing at least four days from his or her normal place of work, or as otherwise defined by the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985.

Reportable accident (non-injury)

An unplanned event that leads to an uncontrolled release, explosion, spillage or other non-injury event as defined by the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985.

Property Damage incident

An unplanned event that leads to damage to property, plant, materials or the environment.

Near Miss incident

An unplanned event that had the potential to cause injury or damage, but did not in this instance.

Insured / Direct Costs

The cost of insurance cover, paid as insurance premiums by the company is the direct cost relating to risk and accidental loss.

Uninsured / Indirect Costs

The costs of uninsured losses to the company may result from a variety of sources, and fall into two main categories of cost: tangible and intangible. These costs are as a result of an accident but are not insured or in many cases, not insurable under an insurance policy.

Internal costs

Internal costs will affect a system such as a department or a company, as a contrast to a direct impact on external parties. These internal costs may include lost time, damaged equipment and may well be passed on to other parties via increased prices or inability to complete orders on time.

External costs

The impact of external costs will be borne by parties external to the company such as the consumer, customer, the supplier, general public, or society at large.

3.4.5 REVIEW OF RELEVANT LITERATURE

3.4.5.1 Total cost of accidents

Accidents have a direct impact on productivity, efficiency and profitability. Accidents increase the investment that is required in order to achieve the desired output, for example the purchase of a replacement part for a piece of machinery involved in

"The question is not what effective health and safety management costs, but rather what it saves?"
Mike Everley

an accident, as a result of which production has been stopped and overtime is required to make up the production deficit. Accidents also create an opportunity cost – perhaps the cost of paying a group of workers during a production stoppage during which time they produce zero return on investment. An opportunity cost can be used constructively in training, development, and production. The overall cost of an accidents is made up of several components, some direct and insurable and others less visible, and in many cases uninsured.

The true cost of accidents can be determined by considering both its insured and uninsured costs. It is key to consider the effect of uninsured costs of accidents as they have been recognised in previous research studies as having a considerable impact relative to insured losses.

The insured costs are the cost of having insurance cover - the cost of all relevant insurance premiums paid by the company, including Employer's Liability, Public Liability or Property risk cover. The premium paid is the *direct* cost relating to an accident. This premium in turn pays for all 'insured costs' relating to an accident – for example, repair to property, cost of interrupted operations – but only the premium cost is borne (or seen) by the company.

As a contrast, uninsured costs to a company may result from a variety of sources, and fall into two main categories: tangible and intangible costs. These costs result from an accident but are not insured or are uninsurable under an insurance policy. Tangible costs may include the cost of: sick pay, replacement of damaged product; repairs; investigation; lost product; lost packaging; material damage; plant damage; fines; lost production; additional overtime; site clearance and demolition; administrative effort; replacement; penalties; lost orders; lost bonuses; increased overheads; emergency costs; counselling; rehabilitation; consultants fees and the cost of hiring and training replacement staff. Intangible costs including the loss of: goodwill; expertise or experience; public image; brand image; sales; customer satisfaction, as well as poor industrial relations; increased absenteeism; reduced productivity due to morale; and potentially lost future orders.

If any of the uninsured costs actually occur, they are retained by the company, unless there is a method of risk transfer other than insurance in place. It has been suggested by Heinrich (1959) that there is a ratio of £1 of insured cost for every £4 of uninsured cost. Other research has been carried out, all of which suggests that hidden costs are a considerably larger proportion of overall accident cost than insured costs. Sinclair (1967) suggests that for every £1 insured, there is another £6.70 uninsured.

The ratio between insured to uninsured costs has been described by Heinrich as the Iceberg theory. The Iceberg Theory describes that where the insured cost (premium) as the tip of the iceberg (~20%) that is the visible cost of accidental loss : the uninsured loss (~80%) is the submerged or hidden cost, absorbed by maintenance and operations budgets. Therefore, a full investigation into the total cost of accidents can determine what proportion of costs are hidden and absorbed by the company, and enable more effective risk financing strategies to be employed. The ratio of insured to uninsured loss will help demonstrate the effectiveness of the current risk financing strategy. Instead of reliance on traditional insurance, certain risks may be transferred, perhaps to contractors or suppliers, and contingencies can be made for other risks through a risk retention budget. Alternatively, a cost-benefit analysis may indicate that preventative strategies to avoid loss will lead to optimisation of resources.

Continuous improvement as described by Carnegie is based upon small, evolutionary steps rather than revolutionary innovations. The Carnegie Process Maturity model provides a framework for organising these evolutionary steps into 5 Maturity levels that lay successive foundations required for continuous process improvements. These 5 Maturity levels define an ordinal scale for measuring the maturity of an organisation's process and for evaluating its process capability.

Each maturity level is a layer in the foundation for continuous process improvement. Level 3, or the Defined process is that all activities are documented, standardised and integrated into a standard process for the organisation. All projects use an approved, tailored version of the organisation's standard process for developing and

maintaining products. Level 3 processes are used to help managers and technical staff perform more effectively. A 'well defined' process has standardised and consistent capability, where cost, quality and safety are tracked.

As part of Process Maturity, the costing of accidents will not directly enable the company to reduce the number of accidents that exist, but will enable more understanding of the true cost of accidents. This will act as a benchmark for building further knowledge about the cost of non conformance's, in terms of safety, and in impact on production. The cost of accidents study also aims to provide better information for cost benefit analysis, to determine the optimum expenditure required to balance the cost and potential cost of an accident with the cost of effective control measures. For example if it is revealed that a certain type of accident occurs on average 10 times annually, it is worthwhile investigating exactly how much this accident costs the company each time. On the surface it may appear that the accident has a minimal cost, but a thorough costing may show that while each incident has a direct (but insured) cost of £500, it has a further indirect cost of £20,000. Therefore, instead of a total annual cost of £5000 for these incidents, the overall cost is in fact £25,000.

Having calculated the true cost of this type of incident, cost benefit analysis may be performed. It will now add a different perspective when potential control measures are considered, if a one-off investment of £5000 will eliminate this type of incident. The additional knowledge of the actual cost of accidents will provide key accurate information for cost-benefit analysis.

Another benefit is that, with knowledge of the average ratio between insured and uninsured costs, assumptions about the total cost of an accident, where there is incomplete knowledge of hidden costs, can then be made in the future.

3.4.5.2 Analysis of the cost of accidents

The method used by the HSE in 1990/91 has been described in detail of the start of this section. Several studies into the cost of accidents were carried out prior to the Health and Safety Executive study, in particular (Heinrich 1959; Fletcher and Douglas 1971; Blake 1963; Sinclair 1972).

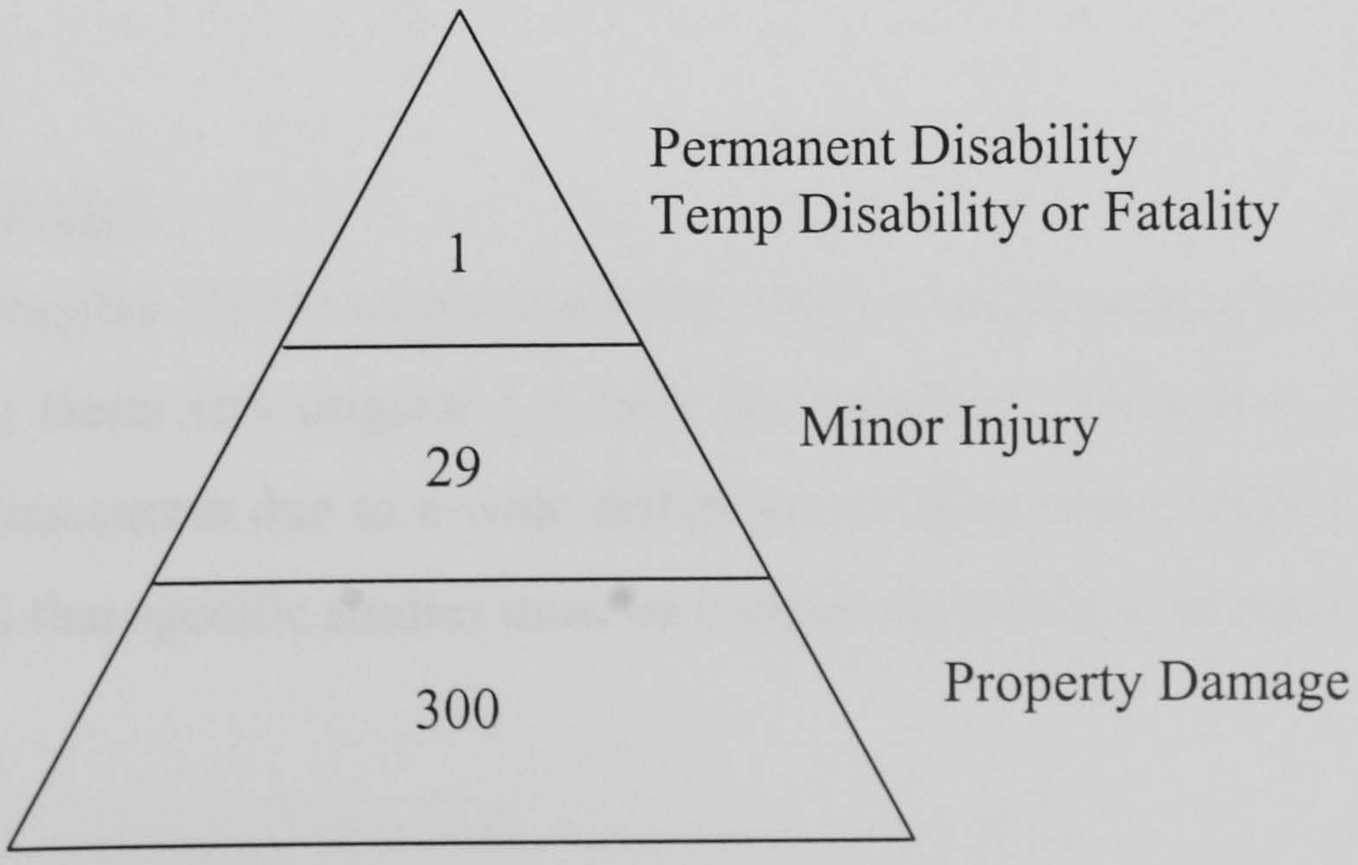
There are many similarities between the studies that have been carried out and there are also several critical differences. Bird, Sinclair, and Blake all used the list of 'uninsured' factors originally proposed by Heinrich. These factors, written in 1929, were used without modification. Sinclair and Fletcher & Douglas also used Heinrich's ratio of Uninsured to Insured costs (4:1), and Heinrich's Accident triangles as a basis for their study.

In terms of differences, many of the studies were carried out using different methods of collecting cost figures, and using different categories or classes of 'loss'. The critical similarities and differences are discussed in Table 8. A brief summary of the main studies is discussed below:

<u>Heinrich</u>

Heinrich was responsible for carrying out much of the original work on the 'cost of accidents'. He wrote an extensive list of uninsured and insured cost factors which has been used in many other research studies. His initial work, presented in 1929 stated that there was a ratio of $4 uninsured cost for each $1 insured. Heinrich considered the results of his costing studies and proposed an accident ratio for three classes of accident: permanent injury; minor injury; no injury, as follows in Table 6.

Table 6



3:124

Bird

As an update to Heinrich's work, Frank Bird (1986) carried out seven years of exploration into 90,000 different accidents to determine, amongst other things, the ratio of accidents between classes. Using the classes: permanent injury, minor, no injury, Bird proposed that the ratio was in fact 1 permanent injury, for every 100 minor injuries and 500 non-injury accidents. In further work, Bird later used a four category ratio of 1:10:30:600. The additional category was created by separating fatality, from permanent and temporary disability. It is not clear why emphasis was put on 'permanence' of injury as this is neither a guide to severity or magnitude.

Sinclair

Sinclair separated costs related to accidents into objective costs (loss of wages, loss of production etc) and subjective costs (life evaluation, pain and suffering). He commented that there was a wide differential in the ratios of insured to uninsured costs across companies and industries that he evaluated. He recommended that particular attention be paid to prevention costs that is, the cost of safety design, personnel, planning, safe operations, medical team, control systems and other similar factors. Three classes of incident were suggested for a costing study,

1 Over three days lost from normal work
2 Minor injury
3 Property damage only

He suggested that Classes 2 and 3 could be predicted from Class 1, using the concept of Heinrich's accident ratio triangles, but he did not calculate these ratios. Again, Sinclair noted that property damage incidents are very difficult to capture fully for analysis.

Fletcher and Douglas

Fletcher and Douglas (1971) emphasised that many companies project true costs of accidents using Heinrich's original 1:4 ratio for insured to uninsured loss, but that this is hugely inaccurate due to a wide difference of these ratios within companies. They suggested that specific studies must be carried out within a company in order to

capture an accurate ratio for those specific circumstances. Company circumstances will vary widely according to the risk financing arrangements in place, legal system and requirement to pay compensation, to name just a few. They suggested that a study must determine the average cost of each of four classes of accident, then divide these costs into insured and uninsured loss. It was specified that a minimum 25 accidents in each class are required to provide accurate information. The accidents were divided into the following classes,

1 Permanent, partial disability or temporary total disability of 1 day or more, death
2 Hospital or medical attention but no lost time beyond a shift
3 First aid treatment only, no lost time other than treatment time
4 No injury - property damage or material damage only

Class 3 incidents were captured by sampling 100 attendees at the medical room, due to the difficulty in capturing this information otherwise. The US National Safety Council's list of uninsured costs was used for the study and samples for each class were costed to capture uninsured cost per incident. The average figures per class in 1971: were,

Class 1 : $52 Class 2 : $21.50 Class 3 : $3.10

These average costs for each class were then used as multipliers for the total number of accident in each class. Fletcher and Douglas observed difficulties in obtaining accurate information about Class 4 incidents – noting that these are of a different nature to *injury* accidents - and used Frank Bird's accident ratio to estimate the number of incidents of this type, and used an average cost of $34.67. This study suggested that there was an average direct to indirect cost ratio of 1:6.

<u>Blake</u>

Blake (1963) carried out initial cost of accidents studies using the definition of accidents as 'unintended occurrences arising out of, or connected with plant operations that interfere or hinder efficient operations'. He determined from this experience that studies would have to span a considerable time period if they are to avoid seasonal fluctuations and are to capture useful information. Blake used

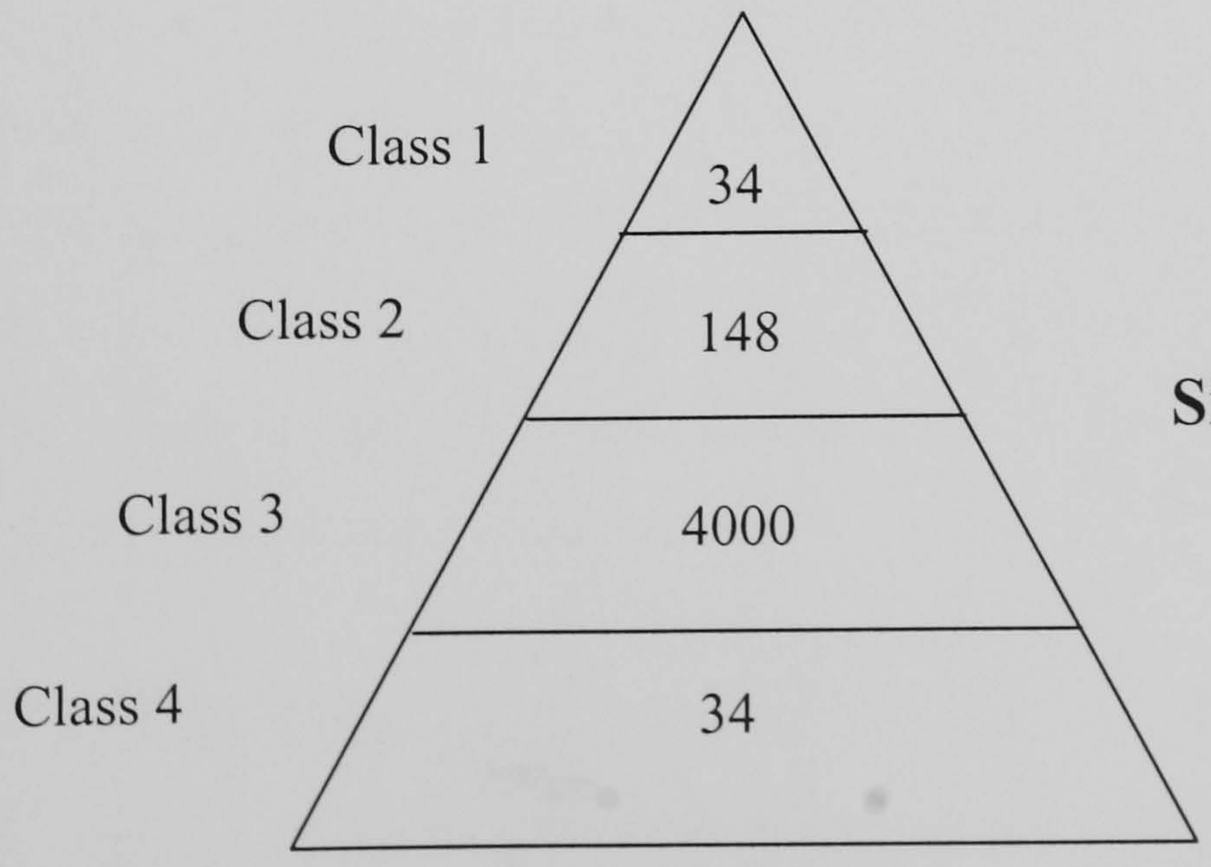
Heinrich's list of uninsured cost factors as a standard, as many other researchers had in previous studies. He carried out several studies that lasted for a period of a year that were largely self administering, excluding non-injury losses. He commented that "almost without exception, the higher the frequency rate, the higher the uninsured cost". It is intuitive that the most frequently occurring incidents are the least likely to be insured, due to an 'excess' on an insurance policy.

Blake applied an alternative method, the *Simonds method (Blake, 1963),* which established average costs for each of four classes of incident within a plant. These averages were then applied to the total number of accidents in each class in a year, to get the total uninsured cost per annum. The average figures were then applied to each year's accident figures, unless there was material change within the plant. The classes of accident were,

1 Permanent partial disability and temporary total disability
2 Medical treatment required off site
3 Medical treatment but first aid only or property damage < $20 or < 8 Hrs lost time
4 No injury accident or minor injury only, no doctor required, property damage >$20 or more than 8 Hrs lost time.

Using Simonds, Blake produced accident *frequency* ratio of:

Table 7



Simonds Method

He commented that the method used to determine the cost of accidents is less important than consistency of methodology and a reliable sample size over a period of time. He discovered difficulty in the complete collation of non-injury data as the study was self-administering.

3.4.5.3 Comparison of studies

It is noteworthy that most effort has been put into the numerical frequency of events, rather than cost. Most studies seem content with Heinrich's ratio of costs with only Blake offering a different approach. The effort put into counting events does not, however, produce clarity or uniformity of results.

TABLE 8

COMPARISON OF CLASSIFICATIONS USED BY EACH STUDY							
TYPE OF INJURY/ INCIDENT	**STUDY (CLASS OF INCIDENT USED)**						
	HEINRICH	BIRD	SINCLAIR	FL & D	BLAKE	HSE	**This study**
Fatal Accident	1	1	1	1	1	1	1
Permanent Disability	1	1	1	1	1	1	1
Temporary Disability	1	1	1	1	1	1	1
Injury with more than 3 Days Lost Time	1	1	1	1	1/2	1	1
Injury but less than 3 Days Lost Time	1	1	2	1	2	2	2
Injury but no Lost Time	2	2	2	2	3	2	3
First Aid Treatable Injury	2	2	2	3	4	2	4
No injury - Near miss or property damage incident	3	3	3	4	4	3	5
UNINSURED COST FACTORS USED	HEINRICH	HEINRICH	HEINRICH	US NAT. SAFETY COUNCIL	HEINRICH	HEINRICH	Derived in this study
COST RATIO (INS/ : UNINS) USED	HEINRICH	BIRD	HEINRICH	BIRD	BLAKE	HEINRICH APAU	Derived in this study

As can be seen in Table 8 there is a considerable difference in classification of accidents in the different studies. *First Aid* accidents, as one example have been put into three different categories. The categorisation of accidents differs widely in several cases rendering numerical comparisons and comparisons of ratios fairly meaningless.

Heinrich, has selected a wide band for accidents that he categorises as Class 1. Bird follows this model and used the same insured/uninsured loss factors and method as Heinrich. In both of these cases, Class 1 encompassed fatal accidents, permanent and temporary disabilities and accidents where the injured party loses more than one shift from normal work. Both of these studies have then combined all remaining injury accidents where there is less than one shift lost as Class 2 and non-injury accidents as Class 3.

Sinclair, by contrast, has not included accidents where there is less than three days lost in Class 1, but has instead combined all other injury accidents into Class 2, and non-injury accidents into Class 3. Fletcher and Douglas followed Heinrich and Bird by taking a wide band 1 and included all injury accidents with more than one shift lost. They then subdivided more frequently into less than a shift lost, first aid only and no injury for classes 2, 3 and 4 respectively.

Blake kept only fatal, reportable and disability related accidents in Class 1, breaking the other three classes down to: off-site medical treatment; first aid treatment and minor or non-injury.

It is possible that the studies were originally performed under different Class headings, but that results were collated under broader groups after the results were analysed. Heinrich and Bird, for example, may have selected broader Class 1 bands to produce more effective visual aids to convince management that action against accidental loss is needed. It is also possible that their studies simply did not define the type of accidents precisely enough to make the distinction into different classes of accident.

Many of the studies grouped together broad sections of less serious accidents. For example, Sinclair puts all injury accidents with less than 3 days lost into the same band, only separating out accidents where there is only property damage. Again this is not ideal for a comparison of relative costs. Assuming that there are dependant factors linking different types of injury accidents, then the study cannot demonstrate a numerical or financial comparison with such broad bands.

Similarly there were several studies that combined relatively minor injuries into the same class as non-injury and property damage. This cannot provide useful figures, as there is no dependant relationship between severity of property damage and severity of injury.

To meet these problems the J&B study used smaller class categories that could be combined at a later date. It separated out reportable injury (fatal, immediately notifiable and over three days lost) accidents from other lost time accidents. The other classes chosen were lost time over a shift but less than 3 days, less than one shift, first aid injury only and finally in a separate category property damage and other non-injury. The larger class 1 band reflected the accident experience in previous years, where few accidents have even been immediately notifiable, so it is inappropriate to split this band up any further.

As a result of the different bands chosen, most accident ratios and triangles are not directly comparable, and this will have to be kept in mind during later discussion.

3.4.6 DESIGN AND METHODOLOGY OF STUDY

3.4.6.1 Introduction

This methodology was developed to suit the specific needs of J&B Scotland for the performance of a cost of accidental loss study in 1994-1995.

The Health and Safety Executive and other studies were considered, but the approach that previous studies adopted required extensive resources and created additional administrative tasks for many parties, or were unsuitable for other reasons.

It was decided that a tailored approach would be most appropriate to ensure that the study within J&B Scotland was not only suitable for its organisational and reporting structure, but also cost-effective.

3.4.6.2 Methodology

Critical cost factors

At the outset, critical cost 'factors' were identified from the findings of previous studies. Costs associated with accidental loss can be described in several ways. This research explores costs under the headings: insured and uninsured costs; and financial against opportunity costs.

Insured costs are the cost of the annual insurance premiums paid by the company. J&B Scotland's Combined Liability premium is the annual insured cost to the company. Uninsured costs however, are those self-insured or retained by the company either intentionally or otherwise, and these have a direct impact on the bottom line. Uninsured costs can be tangible, for example: sick pay; rectification costs; overtime; lost production and damage, however they often may be intangible: low morale and industrial relations problems; loss of corporate image; loss of expertise; poor customer satisfaction.

There are no clear guidelines on the costing of intangible losses, by their very nature any calculation would be speculative and so these costs were excluded from the study. Intangible costs might be expected to increase in some exponential fashion as the perceived severity of the accident increases as, for example, the HSE has proposed for societal aversion. Therefore, intangible cost is a function of financial cost. However, reference will be made to the added cost of intangible losses to the overall cost of accidental loss. All other uninsured costs were accounted for in the study.

At the design stage for this method, the most critical uninsured cost factors were considered to be: lost production; lost time from normal place of work; sick pay; overtime payments; plant and equipment damage; and rectification costs. The study

was designed to enable these costs to be captured as well as other, less significant, factors that add to the overall cost of accidental loss.

Method of data collection

It was recognised that the Cost of Accidents study should be as self-administering as possible to avoid imposing additional administrative burdens on individuals within the company. A study that measures lost time from normal work should not also contribute to this loss of time itself, where this can otherwise be avoided. It was also recognised that a higher level of co-operation would be achieved if the study created secondary benefits that offset any additional burdens imposed at the time.

Historically J&B Scotland had different accident report forms at each site. All of these forms required the following details: the injured's name; location of accident; time and date of accident; safety representative's comments; Department Manager's comments and Safety Department's comments. It was recognised that although the forms were inadequate for the requirements of the study, they provided a useful vehicle for the communication of accident information.

The study, therefore also provided an opportunity to redesign the injury accident and property damage/ near miss report forms and create a uniform data collection format across all of J&B's operations. The critical cost factors would be captured by additional questions on these forms.

At first three accident costing forms were developed: first aid injury; other injury and property damage/ near-miss incidents. The first aid injury form aimed to collect cost information on accidents that required only first aid treatment, the second form to collect information about all other injury accidents and the third form to collect information about accidents that did not result in injury but led to damage or other loss. These forms were discussed within the Risk Control Department and it was recognised that the first aid report form would create an administrative cost at least equal to the actual cost of the accident itself. A study was carried out to evaluate a series of first aid accidents. It was reported that an average first aid accident led to 15

minutes time lost from normal work by the injured party and 15 minutes lost by another party. First aid accidents were then to be captured using a total figure rather than evaluating each one individually, requiring only counting of the incidents. Any property damage costs that related to such an accident would be captured by a property damage/ near miss form.

Data for the Cost of Accidents study was therefore collected using 2 forms - injury accident and property damage/ near miss. The injury accident form included questions that covered the following areas: location of accident; type of injury; severity of injury; lost time by the injured; investigation time; rectification cost; property, plant, equipment, product and packaging cost; lost time of other parties; lost production; Health and Safety Department costs and miscellaneous costs.

The property damage/ near miss form aimed to capture cost information about accidents where there was no injury, unless this was a first aid only injury. The cost factors captured by this form were: property damage; loss of product; plant damage, equipment damage; material, product and packaging loss; rectification cost; lost time from normal work; lost production; investigation costs and Health and Safety Department costs.

Both of the accident cost forms were further improved by the addition of questions which prompt and guide accident investigation. These sections aimed to benefit those carrying out accident investigations e.g. safety representatives, Department Mangers and the Risk Control Department. The forms provided for the collection of a greater range of information that would be available in the event of an Employer's Liability claim.

3.4.6.3 Assumptions about costs during the study

There was extensive consultation with the Personnel Department and the Finance Department once the format of the data collection forms were finalised.

Labour costs

There existed a complex organisational and pay structure at J&B Scotland. The workforce was divided into three groups - monthly paid, weekly paid and hourly paid. Generalisations were made to simplify calculations of sick pay and other opportunity costs. After consultation with the Finance Department on the subject of average rates of pay, it was decided that the workforce could be divided into three categories: shop floor workers; supervisory grade and managerial staff.

Shop floor workers (level 1) encompassed hourly paid workers, unskilled workers and some contractors. It was estimated that the average cost to the company, including National Insurance and other contributions, was £7 per hour. The supervisory grade (level 2) included supervisors, team leaders, tradesmen, skilled manual workers, technicians, some contractors and weekly paid employees. It was estimated that the average cost to the company, including all contributions, was £10 per hour. The managerial grade covered all managerial positions and executives within the company. It was recognised that there may be a wide difference in the hourly rate of pay in this bracket. However, it was expected that there would rarely be involvement at Executive level in accidents or related investigations, so discrepancies would be minimal. The average cost per hour to the company (including all contributions) was estimated to be £15 per hour.

Sick Pay

In event of absence due to an accident, occupational ill health or any other absence, the company pays to the employee his or her normal basic salary, without overtime, plus the normal National Insurance contribution. The exception to this is if the individual has a contractual overtime agreement, where the company pays overtime in relation to this agreement. For the study, sick pay is the cost of an individual being unable to attend work as a result of an accident.

First Aid Accidents

Extensive costing investigations into first aid accidents were not considered to be cost-effective. A short study of first aid accidents had showed that the amount of

time spent completing an investigation form would indeed be disproportionate to the overall cost of an accident of this type. The average amount of time spent away from the normal place of work due to an accident of this type was estimated to be 15 minutes for the injured party and 15 minutes lost by another party, perhaps a first aider. It was decided that instead of completing an accident form, each first aid accident would be accounted for as 30 minutes lost time, which would be calculated against the appropriate rates of pay. The number of first aid accidents and to whom they occurred would be captured by First Aid books either in the medical room or in First Aid boxes on site. Any additional lost time or damage costs were to be captured by an additional property damage/ near miss form.

Material and Spirit Costs

The Finance and Purchasing Departments were consulted periodically on a variety of costs relating to the overall production process to determine the cost of damaged or lost materials and spirits. The financial costs of casks used for the storage of raw spirit, packaging materials for finished product and the cost of the spirit itself as well as other material costs were established by consultation of the Finance Department in event of damage or loss occurring.

Production Costs

In event of a loss of production, the Finance Department and the relevant operating department were consulted to establish the estimated cost of this loss. The fixed costs of the production area were established by considering overhead costs for this period of time including heating and lighting. The production rate at the time of the accident was established.

3.4.6.4 Consultation

A successful cost of accidents study was dependent upon the co-operation and participation of those who were required to complete the data collection forms. It was important therefore, to enlist the involvement and assistance in the study of various key parties within the work force. Initially this involvement was required to help the researcher with the design and wording of the data collection forms.

Presentations were made to the Safety Committees at their monthly meetings to explain the purpose of the proposed study and the method of data capture. The feedback from these presentations was considered and the forms amended where appropriate.

The Risk Control Group, composed of all of the health and safety advisors and specialists within J&B Scotland were consulted again at this stage to carry out a final review of the data collection forms. At this point the Trade Unions were consulted to emphasise that there would continue to be a No-Blame policy in relation to accidents during the period of study.

Finally, all departments at the Strathleven site were advised of the purpose of the Cost of Accidents study, and that data would be collected using new accident report forms. Time was allowed for comments and feedback on the proposed study before the commencement of the Pilot Study at Strathleven.

3.4.6.5 Pilot study

A pilot study was considered necessary to ensure that the data collection forms could adequately capture cost information, and that there were no ambiguous questions. An appropriate sample group and study period had to be selected that would provide enough data to allow analysis of the effectiveness of the data collection forms. The Strathleven site was chosen as the sample group - it had 600 employees and therefore a higher number of incidents than the other sites for analysis. The length of the pilot study was chosen to be one working month, as this financial period was also covered by the monthly accident report.

The pilot study was also intended to help identify problems with the interpretation of the responses, and to identify the appropriate cost figures.

3.4.7 IMPLEMENTATION OF THE STUDY

3.4.7.1 Pilot study

The pilot study was implemented on October 1 1994 at J&B Scotland's Strathleven site. The Nurse disseminated injury accident cost forms (Form 1) at the First Aid room and by first aiders and department Managers on site. The majority of injury accidents at this site are reported to the Nurse, with the exception of first aid accidents, which are also or instead reported to first aiders or supervisors. Form 2 was distributed by department Managers who held copies, and from the Risk Control Department.

The forms were intended to be self-explanatory and directed the respondent to complete certain sections before passing the form to the next relevant party. They were also intended to facilitate and guide accident investigations. Once completed, the respondent signed and returned the form to the Risk Control Department who completed any additional information and costed the incident.

3.4.7.2 Redraft of data collection forms

After the pilot study was complete, the forms were amended as a response to defects that had been highlighted. The most significant alteration to the data collection forms, in relation to actual costing, was to increase the amount of space allocated for each written response. In addition to this, questions on the training received by the injured party on tasks and risk assessments performed were included, but these were not intended to impact on the cost of accidents study.

3.4.7.3 The actual study

The implementation of the full Cost of Accidents study was carried out on November the 1st 1994. The study and new accident report forms were implemented at all 7 sites within J&B Scotland. The study was to last for the period of a full financial year.

The same method of data collection was used as was tested at Strathleven. All accident forms at the Distilleries were sent to a circulation list that included the site

Safety Advisor. The Safety Advisor sent the completed report forms to the Risk Control department at the end of each month for evaluation.

At the Blythswood and Bonhill sites, the Safety Advisor was notified when an accident occurred. An accident report form was then sent out and returned to the Safety Advisor who forwarded a copy to the Risk Control Department for analysis.

The Risk Control Department analysed the data collection forms when they were received. Accidents with missing values or continuing costs were separated from the completed cost studies, and updated until they were complete.

3.4.8 RESULTS OF THE STUDY

3.4.8.1 Overall results

The cost of accidents study was carried out for a period of 52 weeks. During this period a total of 410 accidents were recorded. Of these 410 accidents, 389 resulted in injury to employees, the remaining 19 resulted in property damage but no injury.

The breakdown of accidents by Class is illustrated in Table 9 :

Table 9

Class	Number of Incidents per Class	Accident Frequency Ratio
1) Reportable injury,> 3 days lost time	21	1.8
2) Minor injury with < 3 days lost time	12	1
3) Minor injury with no lost time	74	6.2
4) First Aid injury	284	23.7
5) No injury -Property damage/ near miss	19	1.6
TOTAL	410	

It is recognised that the reporting system used to collect data on property damage and near miss accidents did not collect all data on small events. There is confidence however, that the study collected data on a large percentage of the injury accidents.

The greatest proportion of accidents was first aid incidents. A first aid accident, such as a paper cut, can be treated by a first aider or from a first aid box. An interesting result was that there were more reportable accidents than minor accidents with associated lost time. This factor however may be due to morale or industrial relations issues specific to the company at the time of the study. The work force may not feel obliged to return to work at the earliest possible time after being injured. There may even be a financial incentive to stay at home. Alternatively, the result may just indicate that there are actually a greater number of more serious accidents. This figure distorts the accident *triangle*.

3.4.8.2 Overall costs of the study

The overall costs of all the injury accidents that occurred during the study period are illustrated in Table 10:

Table 10

Category of Accident	Total Cost of Incidents in Class (£)	Average cost per Incident in Class (£)
1) Reportable > 3 days lost time	30,358	1446
2) Minor (with < 3 days Lost time)	1276	106
3) Minor (with no lost time)	2730	37
4) First aid injury	996	3
5) No injury - Property Damage or near miss	35600	1874
TOTAL INSURED COST (Insurance Premium)	70,462	
TOTAL UNINSURED COST	70,960	
TOTAL COST OF RISK	141,422	

It is important to note that the costs of injury accidents include related property damage and other costs, with the exception of first aid accidents, where property damage is accounted for in separate calculations.

The insurance arrangements used by J&B included an excess on the first £25,000 of each and every property damage claim. As a result this arrangement offers only protection against catastrophic losses relating to such claims.

There were only 12 minor accidents with associated lost time and the average cost of such an accident was far lower than that of a reportable, at £106. One of the critical differences between a lost time accident and a reportable injury accident is the amount of lost time from normal work as would be expected from the definition of a reportable accident as a more serious event. In addition, reportable accidents also require a greater amount of investigation and rectification costs. The period of absence, and therefore the amount of sick pay paid out by the company for no return is however the dominant reason for the difference between the average cost of different classes of accidents.

Minor accidents, where there had been no lost time, had an average cost of £37. A minor accident has a maximum of one shift of lost time, whereas a minor with lost time is at least one shift lost, up to 4 working days lost from normal work. Similarly, although there were many first aid accidents, the average cost was low at £3 as there was a minimal amount of related lost time and critically, all related damage costs were calculated separately. In this study, no direct relationship between the severity of property damage and period of time absent from normal work could be identified.

Although there were only 19 property damage/ near miss accidents reported, the average cost of these accidents was relatively high at £1874. As explained before, small property damage events were not adequately captured by the study. It is significant that many incidents in this class did not result in any physical damage requiring repair, only lost opportunity such as down time, and that these costs were still significant. The accidents that were reported tended to be more major incidents.

Frequent incidents such are rarely recorded and cannot be claimed against due to the excess on the insurance policy. However, in cumulative terms it is expected that they cost the company a considerable amount every year.

Insured v Uninsured Costs

The 'insured' cost to the company during the study period was £70, 462. This is the cost of the combined risk insurance premium apportioned to J&B through IDV. In this study, in addition to the insured cost, there was £70, 960 of uninsured costs, bringing the total cost of risk up to £141,427 in the period of study. In this study, the ratio of insured to uninsured loss is approximately 1:1.

Injury Accident Ratio

The analysis of accident rates suggests that there is a correlation between serious accidents and less severe injury accidents. That is, that they have similar distribution and could be grouped. Equally, the minor and first aid accidents seem to be different from more severe events but capable of being grouped together. The data from the J&B study suggests that for every 2 reportable injuries that occur, there will be one lost-time injury accident and 33 first aid (and minor) injury accidents. Relative to other studies into accident ratios, the result of 2 reportable injuries for every one lost-time injury is unusual, but there may be underlying causes, and these discussed below. By separating accidents with lost time from those with no lost time, the lost time/ no lost time ratio is 1:11. That is a ratio of minor to serious injury events of about 11 to 1. This ratio can be compared to Heinrich's 29:1, Blakes 20:1 and Bird's 100:1. Why then are there proportionately more lost time events at J&B than reported by these other studies ? There are three possible contenders.

First, the payment of bonuses or sick pay may not encourage workers to return early to work. At the Blythswood site, if an employee is unable to work due to injury they are paid in their absence, average earnings for previous three months, which includes bonus and overtime. During certain periods of the year there will be peaks and troughs of overtime. It is possible for an employee to have an accident in a period of low activity where the total remuneration is relatively low and get paid a rate based

on a period of high activity in the previous three months. There is therefore no incentive to return to work as the employee actually receives a higher income receiving sick pay than working.

Secondly, the result could indicate low morale within the work force or an industrial relations problem. If there is poor morale amongst the work force they may feel no incentive to return to work.

Thirdly, the result could suggest that if certain events happen then they produce serious accidents. This may suggest either the nature of a specific aspect of the work, or a failure in the physical control mechanisms that exist within the company's operations. Alternatively, it could suggest that there is a lack of training or supervision for high-risk activities.

Further scrutiny of 'serious' events was required to identify the root causes of the accidents, and assess which of the three factors was contributing to the relatively high proportion of lost time accidents. In the J&B study, it appeared that each of the factors contributed. At Blythswood the high rate paid for sickpay certainly played a part – absence rates peaked and troughed throughout the year. At the other sites, the actual physical work – in particular a large number of manual based jobs leading to back injuries - meant that when an employee was injured, he or she was absent for a long period of time. It was also clear that when morale was poor, employees had longer absences. Finally, a company failure to manage absence effectively led to employees, who had received work related injuries, having prolonged absences. Further examination of these factors is out with the scope of this study, however it is useful in building an overall picture of accidents.

3.4.9 CRITICAL COST FACTORS

After the study, it was determined that there were a number of key factors, which were responsible for contribution to the total cost of accidents. The critical factors differed for injury accidents and non-injury accidents.

3.4.9.1 Injury Accident

As is to be expected, the principal factors that contribute to the uninsured cost of injury accidents relate to the injured party. The factors are in order of importance. Had there been a fatal accident or other very severe injury accident however, it is expected that some of the factors would be in a different order albeit the factors themselves would remain the same.

1 Wages paid to an injured employee for no return (sick pay).
2 Wages paid to any other employee with no return for performing an activity outside the normal scope of their employment.
3 Lost production and all overtime required to recoup this production.
4 Incident investigation
5 Property damage and associated rectification costs.
6 Miscellaneous costs

A cost of accidents study in the future could be carried out by further use of the Costing forms. Alternatively, estimates can be obtained quickly by costing the key factors for injury accidents. The formula outlined below will not capture all of the costs related to the incident as it focuses on the key cost factors but it is far quicker, and requires minimum resource and administration time to perform.

a. Costing an Injury accident

Cost IA = Cost of Lost Time of Injured (including sick pay) + Cost of Lost Time of others (including investigation costs) + Cost of Lost Production (including overtime)

3.4.9.2 Non- injury accident

The primary factors significant to the overall cost of a non-injury accident are listed below.

1 Property damage and replacement costs.
2 Rectification costs
3 Wages paid to an employee with no return for performing an activity outside their normal scope of employment.

4 Lost production

5 Incident investigation

6 Miscellaneous costs

Importantly, it was discovered that whilst some factors are dependant upon each other, others are completely independent.

Certain cost factors are dependent. In injury accidents, the more serious the injury, the greater the length of absence by the employee and so the greater the amount of sick pay that will be paid out. Also related is that the more serious the injury, the greater amount of time that is lost by other employees whilst investigating this accident and whilst carrying out other activities related to the accident which are not part of normal activities.

In property damage incidents, the more serious the extent of damage, the higher the costs will be to rectify this damage, and the greater amount of time that will be lost from normal work whilst the rectification takes place.

It does not necessarily follow that the more serious the level of injury, the greater the loss of production. Loss of production is dependent on the area the accident occurs and the level of automation of this area. Similarly, there is no connection between the severity of injury and the extent of property rectification costs as these costs are dependent on the circumstances of the accident, not its severity.

It is possible for an accident to result in permanent disablement but neither stop production (unless stopped by the HSE) or cause property damage. However it would definitely result in high sick pay, high investigation costs and high amounts of lost time from other employees

Similarly to injury accidents, a simple formula can be applied to calculate the key costs linked to a property damage incident.

b) Costing a Property damage accident

Cost PD = Cost of Lost Production (including overtime costs) + Cost of Lost Time from normal work + Cost of Repair, replacement or rectification costs

Finally, another calculation is required to simplify the costing of an accident that caused both injury and property damage. This formula, like the previous two cannot capture all information, but focuses on establishing key costs. Because the severity of injury and the level of property damage are not interrelated, a different calculation must be applied.

c) Costing an Accident with both injury and property damage

Cost IPD = Cost of Lost Time of Injured (including sick pay) + Cost of Lost Time of others from normal work + Cost of Lost Production (including overtime costs) + Cost of Repair, replacement or rectification costs

3.4.10 DISCUSSION

The study has determined that the company suffered significant uninsured losses of £70,760 in the 12-month study period. The study did not account for all non-injury losses, so it is expected that this total uninsured loss figure is a conservative underestimate. In addition, during the study period an insurance premium of £70,462 was paid – therefore there was a total cost of risk of £141,422, and the ratio of insured/ uninsured loss was 1:1.

The main benefit of the Cost of Accidents study was that it provided useful information with which to make decisions on financial risk management. The following recommendations were made:

1 Consideration of Risk Finance Arrangements:

J&B should consider alternative arrangements to finance losses as a result of injury accidents. Under the existing insurance arrangements, J&B retained a significant share of costs resulting from injury accidents. Many of the costs relating to injury accidents are, however, uninsured and others are uninsurable. J&B Scotland retained the first £25,000 on every property insurance claim, but there was no formal excess on the liability insurance policies. This decision had been made by out with J&B Group Risk Finance. It was proposed that J&B Scotland negotiate a formal 'excess' to their Liability insurance policies, and *formally* retain costs below a threshold. Any

claim above this threshold or above an accumulated total per annum would remain the risk of the insurance company. It was felt that this would result in a significant reduction in the annual premiums paid. In a year where there is poor accident experience, however, the company would have to absorb larger amounts of financial risk providing an incentive to improve.

Analysis was then carried out to determine the effect of a deductible using a hypothetical excess of £10,000 on each and every claim. Most Employer's Liability claims, were for noise induced hearing loss however and it was found that this option would not be cost-effective because the vast majority of such claims are settled at amounts less than £10,000, and all of these costs would be retained by the company. In addition, many injury claims were also settled at below £10,000. In short, for a marginal reduction in premium (insured cost), there would be a substantial increase in retained (uninsured) cost. Further work was performed to analyse the effect of different levels of retention on uninsured cost, but there was marginal difference in insured cost for accepting additional risk.

A key benefit of this Cost of Accidents study to J&B was that useful cost and accident information was collected and analysed. This enabled examination of the existing risk finance arrangements, and a number of alternatives to be considered although no changes were made.

2 Redistribution of Insured Costs

At the time of the study, the insurance premiums charged to the individual businesses within IDV did not reflect their relative risk and loss experience. The study recommended that premiums should be allocated to reflect the relative levels of risk, and reward improving or deteriorating performance.

In addition, this study recommended that there should be further redistribution of premium to individual operating units and sites based on accident experience and manpower levels. Each unit should be charged equitable premiums in relation to their risk and experience, and each would be subject to a deductible on accidental

losses. Each department would be required to budget for insurance cover and for the retention of accidental losses. This was still being considered at Executive level when the study finished.

3 Improvement of non-injury reporting

It was recommended that J&B carried out an exercise to identify potential causes of business interruption and property damage within operations, determine the financial and other impacts, and implement preventative measures. The study demonstrated that injury and property damage incidents are independent in respect of severity. In other words, a serious injury accident will not necessarily be accompanied by serious property damage, and vice versa. An example of this is a person falling from a height – there may be a fatal accident but there is no associated damage.

The study had indicated that significant financial losses result from property damage and business interruption, but that the incidents and costs were not being captured. Property damage incidents were inadequately reported unless they were very serious in nature. As a result, the reporting system was modified so that the Security team provided the Risk Control Department with details of property damage found on site during their site inspections, therefore enabling action to be taken to prevent recurrence.

4 Accident Triangles and Absence

The study showed that the famous 'accident triangles' that existed within other studies, were not repeated by this study. In J&B, there were more 'reportable' accidents (4 or more days lost) than there were lost time accidents with less than 3 days lost time and the ratio of no lost time/ lost time events was less.

The study then considered why these figures did not appear to fit into traditional models and accident ratios. One factor certainly was that there was a bonus scheme operating at the Blythswood site, which at certain times of the year, paid people more money to be at home than at work. It paid absent employee's average wages over a 12-week period, rather than the average pay for that week. As a result of the

study, actions were being taken to modify the bonus scheme, with managerial responsibility for pursuing protracted absenteeism.

Another interesting finding was that at the Strathleven site, if an individual has an injury with lost time, he or she often stays absent for the remainder of that week. Employees can self-certificate an absence for 1 week before requiring a Doctors Certificate. It was recognised that reasons for continued absenteeism at the Strathleven site were: low employee morale; lack of discipline; lack of communication between the HR Dept and Management team. This is borne out by the fact that there were no issues of sustained absenteeism at the Distilleries sites, where culture is different and employees with unnecessarily extended absence would be discovered in a close community environment.

The Cost of Accidents study provided the information with which to query some of the current practices, and make necessary improvements.

The study provided an annual cost of accidental loss for comparison with future experience. The study highlighted the costs of safety and the financial impact of safety failures over the period of a year. The overall financial costs were not as significant as had been expected. In truth, when the study started, the researcher had hoped to discover significant cost of accidents figures that would provide a lever to make changes in the workplace. The total costs determined by this study did not match the huge costs found in other studies. There were no immediately obvious reasons for this.

The process with which cost data was captured, even using a simplified process, was time consuming and relatively resource intensive. It is recommended that a cost of accidents study should not be part of an ongoing programme, instead accident costing should be carried out on significant injury and non-injury incidents as case studies. These case studies can be used to highlight the cost of poor loss control and may be used to help build a cost-benefit analysis case for specific safety improvements. This study has proposed shortened methods for costing accidents, and

it is recommended that they are used rather than a full study. The shortened methods will not capture all costs related to an incident, but they are accurate enough to capture the key data, and are certainly more cost effective and practical in an industrial setting.

Interestingly, rather than demonstrate the large annual costs resulting from accidental loss, rather different benefits resulted from the detailed Cost of Accidents study. The study provided detailed information with which to make decisions about the risk finance arrangements. In addition, and also very usefully, it produced a list of key costs in relation to accidents, and identified failures in the existing non-injury reporting and absence management systems. From this perspective, it was worthwhile carrying out a detailed one-off study.

Finally, it was illuminating to review the 'iceberg' and 'triangle' paradigms. Their basis is not as solid as industrial mythology and their place in literature suggests. The study of insured/ uninsured loss is limited with most accepting Heinrich in some form or other. Heinrich's 1:4 iceberg becomes a 1:1 icesheet at J&B.

The triangles at J&B also differ from others. They are less pointed at the top with proportionately more serious outcomes than others suggest. Reasons have been suggested for this and the most probable relates to incentive to work – as the risk of serious injury does not differ by a factor of 2 from other sites- at any level of the triangle.

3.5 THE SAFETY AUDIT -CASE STUDY

3.5.1 INTRODUCTION

The main disadvantages of accident data analysis as a safety performance measure, especially in relation to negativity and the difficulty of collecting data, has been shown. Auditing was also evaluated. This has a long history. Certainly from the 70's external audit for insurance purposes by external consultants was common in the chemical and other high-risk industries. The Loss Control Institute, that developed

the International Safety Rating System (ISRS) was founded in 1974 by Bird and others, although, interestingly even in 1986, Bird was not explicitly recommending management systems audit in his book, *Practical Loss Control Leadership* (Bird, 1986). Here, as with, for example, Lees (1980), the emphasis was on internal processes and standardisation although by that time management audits were being developed. Certainly, by the mid 80's Dawson and others were concentrating more precisely on management systems to control safety rather than technical control systems (Dawson, 1988). Perhaps this emphasis or lack of emphasis was based on the nature of the industries that pioneered safety where the hazard was very obviously technical.

A management audit system has the tremendous advantage in an industry like the drinks industry in identifying gaps in knowledge and procedures. The highest risk *is* technical, but the most active safety failures at J&B were connected with people – training, knowledge, communication, procedures. The way work was done rather than the type of work done. The engineering work of providing guards or other *physical* barriers had been done in the detail, but there had been little attempt (or, perhaps, time) to step back and look at the reasons why accident still occurred. It was felt that an audit system of some sort was essential in order to target *management* of safety and to meet the requirements of the formal Safety Management System that was being developed.

Most auditing systems follow the same general pattern, obviously with variations of content and it is assumed here that the general form of these is known. HSE, for example, provide a summary of a typical audit system in *Successful Health and Safety Management* (HSE, 1997).

HASTAM'S CHASE (Complete Health and Safety Evaluation) II Audit, version 5.1 was selected as an appropriate off-the-shelf system on the basis that it was suitable in content, inexpensive in terms of cost, and simple to perform. The CHASE Audit system was first implemented within J&B in 1994.

3.5.2 CHASE II

As preparation for an audit, a list of documents to be inspected is issued along with a list of individuals to be formally interviewed. The auditor selects these individuals after consultation with the organisation, to ensure breadth and depth of coverage. For J&B, an audit schedule was then issued for each of the 7 operational sites. The total audit across the sites took a total of 7 days, and at each site the process used was the same.

The external auditor (a Registered Safety Practitioner) carried out inspections of relevant safety documentation for each area. Interviews were conducted for personnel spread across company levels, including the managing director, senior managers, supervisors, engineers, operators and health and safety representatives and these were focused around the CHASE II manual.

The manual itself is split into 12 sections, each section allocated a certain member of points, and then these sections further subdivided into individual questions. These questions are given weightings in relation to their perceived level of importance.

Table 11

	Section	*Available Points*	*% Weighting*
1	Legal Requirement	233	12.9
2	Tools, Equipment and Fixtures	190	10.5
3	Machinery and Plant	136	7.6
4	Chemicals and substances	145	8.0
5	Vehicles	135	7.5
6	Energy	116	6.4
7	Health	175	9.6
8	Tasks	169	9.4
9	People	157	8.7
10	Feedback on health and safety	150	8.3
11	Management of Change	110	6.1
12	Emergencies	90	5.0
	TOTAL	1806 points	100%

Interviewees are asked questions from a variety of sections relevant to their position – these being identified at the planning stage of the audit. A positive response

receives points only after verification both by other individuals, and also by hard physical evidence. Unless all interviewees respond positively to each individual question, no points are gained. For example, if the interviewees are asked if there is an up to date Health and Safety policy on site, not only must they all answer yes, but such a policy must also be in evidence. This three part process is key to the audit – it checks that an adequate system exists, that the system is understood and that the system is in place and operating.

After the interviews are complete, the auditor performs a comprehensive physical inspection of site, plant, equipment and documentation and uses the opportunity to carry out additional, more informal interviews. This aims to check to what extent safety messages and rules are being communicated to relevant personnel. An audit report is then issued summarising what has been found under each section, both positive and negative, and proposes the key areas for improvement. A final percentage score is awarded according to the overall conformance with the CHASE system.

3.5.3 OBSERVATIONS ON CHASE II SYSTEM

Whilst the CHASE system was selected as being the most appropriate audit system for the company at the time, it shares many common disadvantages with other auditing systems, and some flaws individual to it. The following discussion, therefore, is in two parts; a comparison with another leading assessment system, TRIPOD (Gall, 1999), and a discussion of common or generic flaws that are implicit to use of audits and regular use as measuring tools.

3.5.3.1 Comparison of CHASE with TRIPOD & specific CHASE issues

One of the principles behind TRIPOD is identification of underlying causes of errors so that faults in the organisational system can be identified and eradicated. Safety behaviour observation systems focus on the identification of unsafe acts and behaviour and then implementing action to prevent them recurring. Focus on unsafe behaviour or errors *after* they have occurred is reactive rather than proactive, and

depends upon the skill and strength of character of the observer (in recognising and reporting unsafe behaviours).

In contrast, TRIPOD focuses on factors that can be controlled. It is a questionnaire study where a number of closed questions (Yes/No) are put to all levels of the workforce. These questions focus on what has actually been experienced by each respondent, not on perceptions. The total of 275 questions is listed under 11 Basic Risk Factors (BRF), as seen in the table below. The questionnaire is held on a computer database – the computer generates a random sample of questions and afterwards performs analysis of the answers so additional patterns can be identified. A TRIPOD Condition Survey shows by histogram the BRF profile, and describes the reasons for these scores - a low score against a BRF shows that improvement is required in the control of that risk factor, for example maintenance arrangements. The Condition Survey lists each BRF and the reasons that control is substandard whether: drivers; resources; methods or outputs, and an improvement action plan is built against this Survey report.

Table 12

Basic Risk Factors (11)	Basic Risk Factors (11) - 25 questions each BRF = Total 275
Specific (5)	Design Tools & Equipment Maintenance Housekeeping Error Enforcing Conditions
Generic (5)	Procedures Training Incompatible goals Organisation Communications
Preventative (1)	Defences

There are a number of specific aspects of the CHASE II system that we shall now examine against TRIPOD.

1 Weighting

Section 1 (Legal Requirement) accounts for 12.9% of the maximum overall points that can be achieved in the CHASE audit system. It is too easy to obtain points for having a safety policy *at all* - the actual content and communication of the policy is not investigated until later sections in the audit. In the interest of scoring 'easy' points, sites may copy another policy, or get one written by a consultant, with no buy in to the policy itself. The number of points allocated to having a policy, and to section 1 in general is too high. It is believed that it is the implementation of a safety strategy that will lead to a good safety performance. In contrast, all 275 questions under the 22 Basic Risk Factors of TRIPOD have the same weighting, and focus on what the respondents have actually experienced, i.e. what has been implemented. In business however, not all occupational safety risks are equal – within J&B, having an effective planned maintenance and test system for fire detection and sprinkler systems would merit a higher weighting than having a VDU assessment.

Section 12 of CHASE is one example of a section that did not reflect the risk level of the Study Company. J&B's greatest risk is that of fire and explosion due to the potentially flammable nature of its product and the contents of its warehouses. Fire has the potential to destroy any of the sites and cause multiple injuries. Within the CHASE system, this section is the shortest and has least weighting, with only 5% of the total available score. It also deals scantily with crisis management, which is another priority for this type of organisation. It is key that the audit system used by a site reflects the risk profile of that organisation - it would be equally inappropriate for a clothes retailer to be audited against HAZOP arrangements.

2 Management

The CHASE formal interviews appear to be aimed at higher levels of management, rather than those directly responsible for implementing health and safety arrangements - the line managers, supervisors, safety reps, co-ordinators and safety practitioners. When employees at less senior levels were interviewed in the audit, many of the questions asked were beyond the scope of that individual's knowledge and influence. For example, the CHASE interview often focuses on the existence of

policies and procedures rather than on actual compliance with legal and company standards. In this audit, operational staff and supervisors are only appropriately involved in the CHASE system when the effectiveness and communication of procedures are being verified. In contrast, the TRIPOD system focuses on what each individual has actually experienced, rather than on their opinions and perceptions, so employees at all levels can be involved at each stage.

3 Site size

CHASE II was appropriate for the largest of the sites, which employed 550 people and had a layered management structure. However, it was found to be inappropriate for the smaller sites that had flatter management structures. The audit results were potentially misleading for the smaller sites as only a couple of individuals could be questioned for each section, so there was limited cross checking. If additional people had been questioned then the questions would have gone outside their sphere of influence and knowledge. It was found that when this was done, interviewees became defensive and therefore their answers were inconsistent.

Another version of CHASE has been written for smaller sites, and is more appropriate. As all 7 sites had different policies, procedures, management and safety standards at the time of the first audit, it would not have been practical or accurate to amalgamate the whole company into one 'site'. This was proved when, as a trial, the 4 Distilleries were audited under the one umbrella. The results and action plan was often found to be misleading and inappropriate – in some cases action improvements would only relate to 1 site out of 4. In general the overall score did not reflect individual efforts or status, and the audit the following year dealt with each site separately. It should be noted that on large sites, different business or production units might also have different practices and standards, which must be captured by the audit.

4 YES/No only

Both CHASE and TRIPOD only allow for Yes (full points) or No (zero points). Neither system indicates if there is partial compliance and awareness of

responsibilities. After the CHASE audit, many respondents felt de-motivated that their efforts had not been recognised at all, when they had spent a very significant period of time tackling detailed projects such as risk assessments.

Without practical experience of TRIPOD, it is hard to identify failings in that system but it is likely that all such systems will have individual flaws. CHASE then, does not reward effort that continues, is aimed at managers rather than implementers and had inappropriate weighting for J&B. These flaws are specific to CHASE, but there are broader criticisms of audit systems that are generic by nature.

3.5.4 GENERIC ISSUES WITH AUDITING

1 Technical content

Many audit systems have been written with an industry or a set of risks in mind, so often there will be irrelevant questions and sections or just a general focus that is either not relevant or not adequate for the company's requirements. The focus of different audits system should be considered before one is selected.

In some cases, irrelevant questions or subject areas cause confusion in interviews, however under the CHASE system, the company automatically lost points for not having certain things in place, even when they were not applicable. This can be influenced by the stance of the auditor and leads to subjectivity.

2 Positive Acquiescence and/or defensive responses

During an audit interview (for most audits), it becomes evident to an interviewee that the desired response is 'Yes' if points are to be achieved. There is a risk then that the interviewee will answer 'Yes' automatically, regardless of the real status, and possibly without thinking about the question. This was witnessed in many of the CHASE interviews, primarily at management level. Some individuals were aware that it would gain them additional points, and others were simply assuming that the situation was in control and did not actually know what the reality was. This factor cannot completely alter an audit score, as in many audits the points are also based on physical verification, but it can mislead the interviewer. It also means that a very

thorough physical inspection is required. A positive advantage of the audit interview process is that it can help raise awareness by drawing interviewee's attention to gaps in the safety systems. If an individual is feeling attacked and defensive, however, these lessons will not be taken on board. This creates a problem as the true attitude; level of awareness and knowledge of that individual will not be captured in the interview. The interviewer may only get the answers that he or she *wants to hear*.

3 'Honesty' of answers

If people within a company have the belief that safety standards are good they will answer positively for most questions. It is not practical for each and every line of questioning in the CHASE system to be physically verified on site. In this and other audit systems, many questions are answered subjectively, and these perceptions can produce an inaccurate picture of actual safety standards. It can also lead to a false impression of the level of commitment within a company and screen underlying issues or problem areas. In many cases, managers who are committed to safety and admit the failure of specific safety aspects within their control are penalised against those who are motivated to gain a 'good' personal score, regardless of the actual status of their area. There is then some enticement to answer dishonestly. It is critical then that praise or rewards for good and improved safety performance is based on verification at all employee levels and with hard physical evidence.

4 Subjectivity of auditor

Although in some audits an interviewee can answer directly yes or no, it is generally expected that this response be justified. In some audits it is up to the interviewer to determine if the response given was adequate to be worth a point or not. Clearly, the skill, experience, site knowledge and bias of the auditor can have a huge impact upon the final scores. This would cause even more disparity if there were more than one auditor - either at the one time, or over a period of time.

Problems are also caused by the physical verification, where a situation is defined as satisfactory or unsatisfactory. What may be satisfactory to one auditor may be unsatisfactory to another, and even an individual may change his or her opinion over

time, dependant upon personal factors such as concentration and recent experience. An inherent flaw of many audit systems is that an audit may be carried out one year with say 30% achieved. The following year after significant improvements but with a different auditor the score may only reach 35%, not reflecting the progressions made. Unless a comprehensive set of notes is written to indicate the rationale behind the points awarded, the following audit is difficult for the auditor. The auditor is highly significant not only to the score, but also to the impact of the audit upon safety standards (which is the audit purpose), and on the improvement action plan. A couple of auditors with expertise would reduce the impact of personal bias, and could provide a common link over time. Alternatively, the same auditor should be used year on year. Clearly it is key to the usefulness of an audit that the auditor is an experienced and competent individual. Subjective awarding of points and issues without consistency and continuity over time are key disadvantages of auditing.

5 Ambiguity

Some audit questions are ambiguous, vague, and confusing for interviewees, even when read with the explanations in the handbook. In the CHASE manual, the language was often vague and academic rather than written for safety practitioners, making the questions difficult to answer. In some cases, the wording of the audit may be appropriate for the top end of a management scale, but may not be particularly appropriate for supervisory level and below. The interviewer will then interpret the questions for each interviewee, introducing further subjectivity, both his own and that of the respondent.

6 Repetition

In some audits, including CHASE, there is a great deal of repetition of similar questions within the audit interviews, for both the auditor and auditee. It was noted that this led to boredom on both sides and less thought was then put into responses.

7 Interrogation

Audit interviews can lead to a feeling of interrogation of the interviewee, who can become defensive. During the CHASE process, many interviewees across levels

voiced their concern at the interview process. Their impression was that the questions were directed at their inadequate knowledge or performance in health and safety terms. After the first day's interviews, all further interviewees were told that the audit intended to determine the performance of *the company*. Although the intention of an audit is to establish the actual current safety standards and deficiencies so that improvements can be made, defensiveness can lead to that aim being all but eliminated. As an observation, those most guilty of feeling personally attacked were in middle to senior management.

8 Does it actually indicate performance ?

After this general critique, there is the question of what an audit such as CHASE actually measures. There is a basic assumption that the questions it asks, and the direction in which it focuses the company and the auditor, will indicate whether the performance is good or bad, better or worse. There is, however, a possibility that all it measures is compliance with CHASE itself, and that this does not necessarily indicate a deteriorating or improving safety performance. However, the audit does cover all aspects of health and safety management and legal compliance, and includes a physical and documentary inspection. An analysis of health and safety focus and general awareness within the company post audit indicated that the audit process had a positive contribution to the improvement of safety standards, and that it could be further improved on the basis of Drucker's maxim : 'What gets measured gets done'.

3.5.5 CUSTOMISATION OF THE AUDIT PROCESS & SYSTEM

Although these are significant criticisms of CHASE, many of them could be addressed by the Company and the auditor without undermining the basic principles of the audit.

It was decided that, in the interests of continuity, the same auditor would be used to perform the audit each year. The Risk Control function were able to sit in on interviews and participate in the physical inspection, and discuss the findings,

observations and comments of the auditor, to ensure that deficiencies and solutions were clearly identified and understood.

Irrelevant questions were removed before the audit, in the interest of fairness. The audit interviews focused on the failures of the previous audit and the action plans that resulted from this audit, reducing both the length and repetitiveness of the interviews. Physical evidence was checked to ensure that previous measures were still in place.

It was difficult, without complete modification of the CHASE audit, to change any of the fundamental sections or questions that had been identified as being deficient. Therefore in the period 1994-1997, the system was only modified in terms of relevance and interview style, ensuring that an accurate benchmark of performance was maintained.

3.5.6 RESULTS AND DISCUSSION

3.5.6.1 Accident/incident results

After the initial audit in 1994 the audit was repeated annually until 1997. After each audit, action plans were developed and a realistic but demanding target was set for each site, and for the 7 sites as a whole. The objective for the Executive Team at each site was to achieve the target scores for the audit and this attracted a salary bonus. The targets were reset annually. The target scores could be achieved through the completion of action plans focusing on the deficiencies of each site, and within that, each department.

Table 13

YEAR	STRATHLEVEN TARGETS CHASE II TARGET %	STRATHLEVEN RESULTS CHASE II ACTUAL %
1994	39	40
1995	55	55
1996	66	72
1997	76.6	77
1998	Revised system	N/A

3.5.6.2 Impact on safety management directly due to CHASE II

So was there an impact on the standard of safety management as a result of the implementation of the CHASE II, and would there be any impact with an alternative system of this type ? Did the improvement of the scores achieved in the Audit have a positive correlation with a decrease in accident rates ?

There has been a significant impact on safety *management* on site, as a result of the implementation of the CHASE II Audit programme. It helped to provide impetus and focus to safety management within the company.

Each year, after the annual audit was carried out on the sites, a report was produced by the Auditor that identified areas of deficiency; aspects of safety that had been improved; and examples of Best Practice that had been implemented in the audit year. The report allowed areas of weakness to be identified, and where minor or major improvements were required, as well as passing on credit for progress and projects. Action plans were written in conjunction with Department Managers, and commitment to targets was gained at this stage. All departments on the sites were involved in this process, and the targets set were intended to be stretching, but realistic. The Risk Control Department then issued action plans for each of the sites, by department, and target scores for each site to measure overall improvement.

The targets for improvement for each of the sites aimed to ensure continuous improvement of safety management, employee awareness and safety standards on site. The targets were communicated to all employees, and focused on the achievement of specific improvements in each department. To maintain commitment to the achievement of the agreed goals, targets were placed in the personal objectives of the Management team. The objectives were given to the Executive of the company, who in turn placed responsibility on their management team for the achievement of these objectives. The use of personal objectives (with attached bonuses) placed and maintained focus on the achievement of health and safety goals for each full year. Unfortunately only members of the management team were in the bonus scheme, but the team delegated specific tasks and responsibilities in turn to

their staff for achievement of specific improvements. The introduction of the CHASE system improved the focus on occupational health and safety management on site.

Progress against the action plans was checked on a quarterly basis, and in the meantime monthly safety inspections were carried out on site by Department Managers and their safety reps. This helped to ensure that the general standards of health and safety were maintained.

So did the improvement of the scores achieved in the Audit have a positive correlation with a decrease in accident rates ? The table below shows a comparison of the number of accidents experienced against the CHASE score achieved in each year. The comparison takes into account only minor and reportable accidents – first aid accidents are excluded as they are shown to form a different population.

Table 14

Year	Minor Accidents	Reportable Accidents	Total Accidents	CHASE Actual Scores %
1992/3	100	15	115	N/A
1993/4	73	12	85	40
1994/5	66	9	75	55
1995/6	58	6	64	72
1996/7	90	10	100	77
1997/8	89	12	101	N/A

There was certainly no significant decrease in the number of minor accidents or lost time accidents between 1990 and 1995, although there were significant decreases in monthly figures.

So was there an impact on accident statistics as the CHASE scores improved ? Was there a reduction in accidents, or an improvement in safety standards, or just an improvement in management systems – or is this just the same thing ? Does the system eventually outlive its usefulness, and when? And what do you do about it?

There are many other factors influencing the accident data. In October 1997, a 3-shift system was introduced increasing the number of employees and hours of production worked. However, this did not appear to affect the accident data in 1997/8. In 1998, as a result of a merger, there were many organisational restructures and a significant impact on morale, spiralling to a new low in June 1998 when the site closure was announced. Culturally, at Strathleven, most accidents that are reported turn into liability claims against the company. This 'claims culture' does not exist at the other sites. The claims culture and the on site Medical Department provide a higher reporting rate of accidents at Strathleven than at the other sites. This is one of the reasons that accident monitoring cannot be taken in isolation as a measure of safety performance.

The use of the CHASE II audit system also promoted the use of Safety Co-ordinators. The system identified that to achieve proactive safety management on site, more than one trained voice must be used. In the five main areas on site, safety co-ordinators were appointed and trained to NEBOSH Certificate level. The safety co-ordinators were selected at middle management level to provide focus in their individuals departments, or zones, they also therefore had decision-making responsibility within their areas for safety and other improvements. The safety standards in each of these areas increased, as there was day to day focus in each of these areas. This allowed the Risk Control Department to provide specialist advice, company strategy, and training. The system provided a more effective use of resource than a safety policeman having to cover a whole site on his or her won, with no provisions in time for developmental work.

The interviews of employees on site clearly demonstrated that there was a perceived benefit of the Audit system, it was often cited as the tool that provided the impetus for continuous improvement. Employees at all levels within the organisation, from the Executive to employees on the shopfloor cited the CHASE system as having had a clear impact on safety standards and in particular safety awareness on site. Some employees commented that the company had improved its verbal commitment to

improving health and safety on site, although concerns were still voiced about follow through on issues.

3.5.7 REVIEW AND RE-FOCUS OF THE AUDIT SYSTEM

In 1998, the audit system was completely revised. The original audit system had been very successful, but it was recognised that it had outlived its useful life, and there was no longer the same challenge to achieve targets. There was a concern that individuals or departments would become complacent after a period of time, as they believed that the achievement, particularly of 70%, had already been made. Some of the criticisms of the system itself were taken into account to make it more relevant for the company and for the drinks industry as a whole.

The Risk Department had been moving towards integrated risk management for some time, finally integrating all aspects of risk management into the function in January 1997. It was determined that the revised audit should cover other aspects of risk management than health and safety, whilst not reducing the safety content of the audit. The audit included new sections on security, business interruption, crisis management, HACCP (product safety), and environmental management to reflect the revised scope of the department. The integrated system removed the number of auditors on site, the frequency of audits and the lost time of employees on site. The revision of the system then raised another question: who would audit the company against a risk management system? Clearly an auditor using this revised system would either be a multi-skilled risk management professional, rather than a single discipline specialist, or alternatively the company could be audited by a small group of specialists.

The section on Fire and Emergency was rewritten, as it was perceived to be inadequate in depth and focus for the risks faced by the drinks industry. This section aimed to bring focus to the major risk to health and safety of employees, and to the continuity of business operations of the company. Similarly, questions and sections that were deemed irrelevant were removed from the audit, helping to shape the system specifically for the J&B Scotland.

Another major change was the revision of the weighting of specific questions within the audit, as this weighting appeared inappropriate in some cases. For example, there were 20 points attached to having a safety policy, but only 5 points for its communication, and/ or contents of the policy. The researcher and the external auditor considered each question in the CHASE II system for its relevance and its relative weighting, removing irrelevant questions, modifying weighting, and adding new, more probing questions. Many of the questions added related to previously identified deficiencies, others specifically to the industry, and others to new pieces of legislation. The overall effect was that the revised audit system was more relevant, more focused more probing and therefore it was more difficult to achieve targets. The system aimed to provide a genuine focus to risk management within the company on a minimum of a 3-year period, with particular emphasis on deficiencies that had been previously identified.

It was recognised that an audit system must be consistent for a period of time, to provide a benchmark from year to year. However, to facilitate continuous improvement, this system must be revised or changed regularly - perhaps every three years- to ensure it continues to have impact. The greatest benefit of this audit system is the focus on safety that it provided (HSC, 1993).

3.6 SUMMARY : MODEL OF SAFETY PERFORMANCE INDICATORS

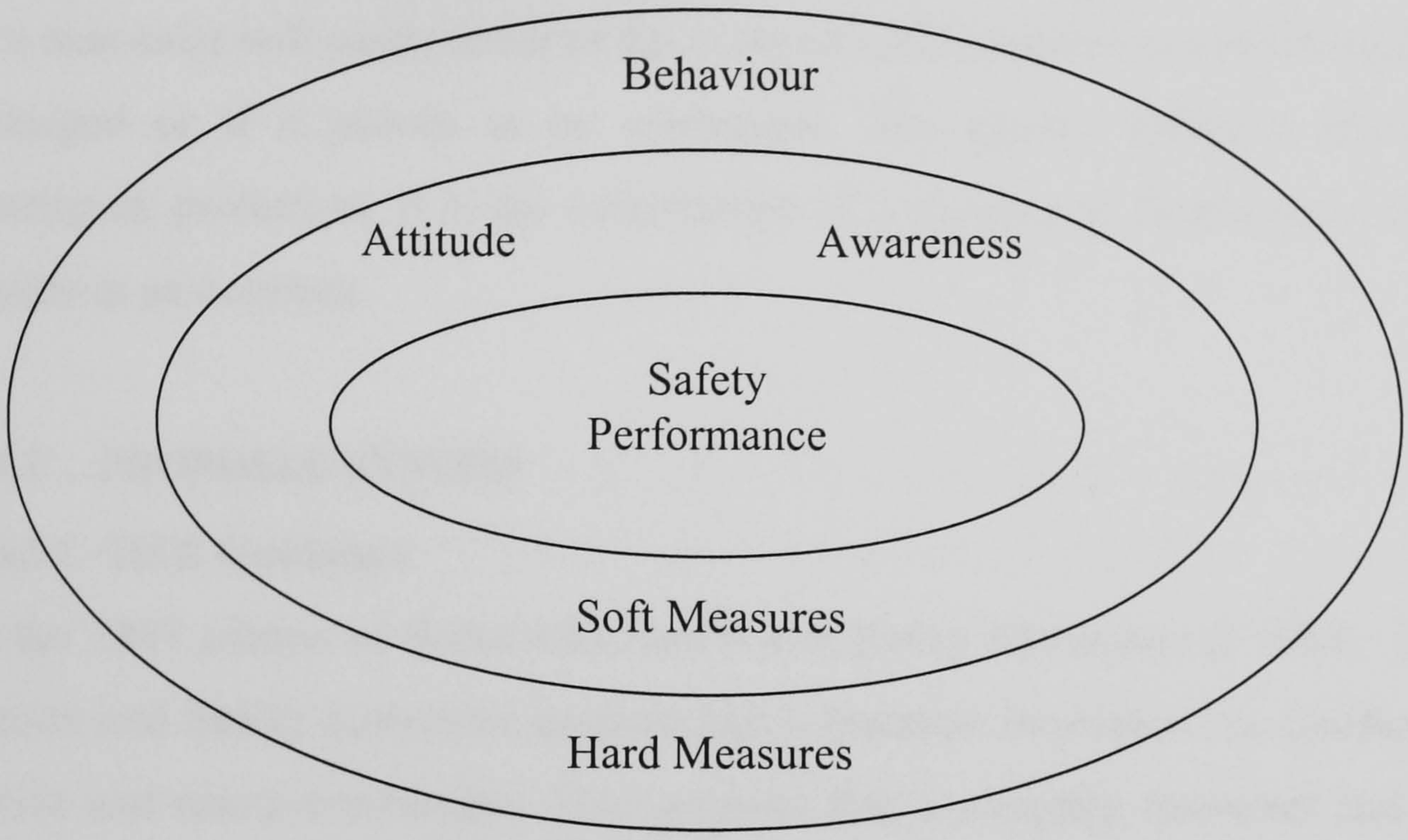
3.6.1 SAFETY PERFORMANCE MODEL

A comprehensive safety measurement system must encompass a number of different components to gain an accurate picture of safety performance. The overall aim of a measurement system is to capture relevant, *usable* information that informs whether the safety management system and processes are working or not.

To get an accurate performance measurement, the system must include both hard and soft performance measures - the soft measures to assess awareness, knowledge and indeed perhaps attitude and the hard measures focusing on physical evidence and

data. The combination of these measures will assess whether the overall system is working or failing and what action that is required on deficiencies.

The following model illustrates the Safety Management system and the performance measurement system.



If a safety management system is working, hard measures such as audits, safety inspections, and behaviour observation will identify safe behaviour, compliance with policies and procedures and a safe work place. Soft measures such as interviews, questionnaires and surveys will indicate awareness and knowledge of safety requirements.

In contrast, if the safety management program is not effective, hard measures might be expected to identify unsafe behaviour, increased accident rates, non-conformances with policies and procedures, and hazards – all of which will be backed up by a lack of knowledge and awareness. Employee 'real' attitudes (not expressed attitude) can also impact upon safety performance, but because we are unable to relate attitude to a resultant behaviour, it is not a useful measure.

If a safety management system has failed, there will be non-conforming behaviour or a lack of safety awareness. The effect may be latent in that, although no incident has occurred, the potential for an accident has increased. If, for example, safety rules are

being breached - perhaps by an employee neglecting to wear a safety harness while working at height, or safety control systems are being circumvented - then the potential for an accident increases. In some cases there may be non-conforming or unsafe behaviour but the control systems in place are adequate to prevent injury or harm, for example platform guard rails or machinery guarding. However, an injury or a near-miss will easily occur in the event of such a control system being removed, damaged or if it proves to be inadequate. The system defences fall back on *contingent* protection. It is the combination of a number of factors and events that results in an accident.

3.6.2 PROPOSED SYSTEM

3.6.2.1 HSE Guidance

In the 1997 edition of Successful Health and Safety Management (HSE, 1997) the Health and Safety Executive propose that a business implements a combination of active and reactive measures. They propose that a company measures and rewards achievement instead of focusing purely on safety failures and deficiencies. They suggest that whilst investigation into deficiencies creates an opportunity to 'learn from mistakes', valuable knowledge should also be gained with proactive techniques such as behavioural observation, inspections and auditing. This is in contrast to the first edition of this HSE publication in 1991, where the focus had been on reactive (negative) measures of safety performance, that is mainly accident and incident investigation.

There is little to disagree with in the intent, but there is still precious little discussion or guidance given about the use of proactive measurement tools in HS (G) 65. HSE still focuses the vast bulk of its effort on providing detailed guidance on the negative tool of reactive investigation. It is stated that reactive systems should focus on monitoring safety objectives and compliance, and should include: routine procedures to monitor specific objectives; periodic examination of documentation; frequent physical inspection; health surveillance; direct observation of work by supervisors; implementation of an audit system; and regular reporting on performance to Senior Management. There is however, no guidance on the techniques to be used or

guidance on frequencies and time-scales. On the other hand, detailed guidance is given on reactive investigation, and it is suggested that the following be investigated: injuries, ill health; sickness and absence records; property damage; near-misses; hazards; weakness in standards; and incidents with potential. The intention of each of the investigations is to identify the immediate and underlying causes, with specific focus on events that may be repeated.

3.6.2.2 This Study

This study proposes that a combination of soft and hard performance measures will provide a positive performance measurement system. An effective measurement system has to provide useful, timely information that will highlight the successes and failures of the overall safety management system, and enable specific focused improvements to be implemented. It is central to the effectiveness of the measurement system that the *right* measures are used at *effective* intervals – neither too often nor too infrequently.

3.6.2.3 Inspections and checks

To be effective, physical inspections and hazard notification must be carried out on an ongoing day to day basis. Key inspections (of plant, premises and equipment) should be included in a Planned Maintenance system and carried out daily, weekly or monthly dependant upon the level of risk. Other more regular checks and inspections will be included in work instructions and safe systems of work. Hazard notification, for example, should be carried out on an ongoing day to day basis, interlock checks and inspections carried out daily on start-up, and physical inspections with safety representatives carried out monthly. It is very important that documentation is kept of these checks and inspections, and these records should be monitored regularly by Supervisors, and again during audits and Executive safety tours.

3.6.2.4 Investigation of events and simplified costing

This study proposes that all incidents and near misses should be investigated and assessed as and when they occur. The investigation should aim to identify root

causes and the preventative measures required. In addition, to provide an overview of trends, overall accident and incident data should be evaluated annually to identify trends in types or locations of accidents. Trends in incidents will help to build a picture of specific areas that require focus and improvement, and will also show areas where performance may have improved, perhaps as a result of a campaign. As has been discussed previously, to provide an accurate picture of the accident rates, a minimum of 5 years data should be used during the annual review of data. Every 3 years, overall trends in accident data should be evaluated. It is critically important that equivalent information on production, staff levels and hours worked is collated with the incident information.

Costing each and every accident, even with the simplified methods proposed, can be extremely time consuming and in truth, not particularly useful for the safety practitioner. It is recommended that simplified accident costing studies be carried out on specific accidents/ incidents to illustrate the financial impact of an accident in the workplace. One option would be to cost all Reportable accidents; another would be to cost significant incidents as and when they arose.

3.6.2.5 Observation

Intensive observation of behaviour in the workplace is resource intensive but can be useful to provide a specific focus where employees are not following procedures or failing to wear safety equipment. An area, task or activity to be *observed* may have been highlighted in the annual accident trend review. To be effective (in terms of cost as well as time), observation should be used on a specific issue or problem only, rather than on an ongoing basis. Behavioural observation was not used by J&B during this study due to its demands on time, resources and the skills required to conduct such a study. There are also doubts over the real contribution to knowledge given that human behaviour changes so readily according to circumstance. It seems likely that those observed will be influenced by the *Hawthorne Effect* during the period of observation, and thus, will not demonstrate 'normal' behaviour. Moreover, as internal auditing and safety inspections provide feedback on compliance with safety procedures and the use of control measures, if the auditors are made aware of

a potential problem area, they can integrate a less intensive behaviour assessment into their audit or survey.

3.6.2.6 Awareness studies

Specific awareness surveys by questionnaires and interviews should be carried out in problem areas when required. On a periodic basis, perhaps every 3 to 4 years, they also provide a useful focus to determine if improved results indicated by the hard measures reflect a real change, or a co-incidental numerical improvement. The results will indicate if previous campaigns have actually been successful, and identify training needs.

3.6.2.7 Audit of Safety Related Management and its development

This study proposes that a safety audit including an employee interview, thorough physical inspection and verification, and documentation check should be carried out on an annual basis to provide a benchmark for safety performance. The audit would be carried out verify that management and control systems and documentation exist, are being used, and that all reviews and improvements are being made. The annual audit provides a snap shot over time to compare medium term progress.

It is key that this audit system is updated every 3 years to maintain the impetus for improvement. The updated/new audit system must be refocused - it should improve on the previous systems gaps and weaknesses, reflect internal and external changes, and most importantly set new safety performance standards and expectations. It should be remembered that by changing the audit system, the previous benchmark can no longer be used, and there must be clear communication surrounding the new audit to avoid it having a demotivating effect.

3.6.2.8 Annual formal review, planning and incorporation in reward structure

Finally, there should be an annual formal Safety Review, which encompasses all aspects of safety performance measurement and indicates whether the overall safety management system is working or failing. The Safety Review should cover accident data trends; survey results, safety audit results, and put forward an action plan for

improvement for the next 12 months. To provide and maintain focus, the results of this review should form part of the management bonus scheme.

Table 15

The following table summarises the Proposed Model :

Frequency	Hard Measure	Soft Measure
Ongoing/ Daily□	Physical inspection Hazard Notification Accident/ Incident/ Near-Miss Investigation	
Monthly	Safety Representative Inspection Management monthly documentation checks Collection and processing of incident and production data	
Annually□	Accident Data Trends Review Annual Safety Performance Review - covering all techniques Safety Audit - physical inspection & documentation checks	Safety Audit –awareness interviews
3 Years	Safety Performance Review – accident trends, 3 year audit results, 3 year plan for improvement	H&S Awareness benchmark questionnaire/interview study
Specific workplace safety Issues□	Intensive Behaviour observation Accident Costing	Interview study□Survey□Questionnaire study

This study recommends that an effective performance measurement system will include a number of different tools that will combine to build an accurate picture of OHS performance. The model includes short, medium and long-term measures that provide feedback at different times, and on different issues – all of which enable safety standards and objectives to be set. The model illustrates the combination of tools and the frequency with which they were used at J&B.

4 ATTITUDES AND BEHAVIOUR IN THE WORKPLACE

4.1 ATTITUDES AND BEHAVIOUR

4.1.1 BACKGROUND

There is no value in implementing elaborate safety management systems, training schemes, procedures and control systems if they will have no effect on safety performance in the workplace.

There has been extensive discussion of the measurement and development of a 'safety culture' (McSween, 1997). The question remains - even if a safety culture actually exists, is it tangible? We have to consider what aspects of safety performance are actually 'visible' in the work force so that they can be measured to help evaluate if any changes have actually affected standards. Such performance indicators will attempt to evaluate either safety *attitude* or safety *behaviour*.

Conventional safety performance measures rely upon the visible effects of safety in the workplace, that is, they focus on the results of safety behaviour. Behaviour is very visible in the work place, although the results of behaviour can be hidden - such as unreported near-misses. It is difficult however, to hide all behaviours and certainly appropriate skilled supervision and auditing will identify failure to follow rules, failure to wear PPE, accidents etc. What supervision cannot identify is the *intent* or reasons behind any mode of behaviour or action in the workplace – this requires deeper knowledge of the people involved and much of the theory, however, and certainly much of the rhetoric is around safety *cultures* – that is safety attitude.

Behaviour is far easier to measure than attitude and it is certainly less complex to understand. Measurement of attitude relies on the premise that expressed attitude is linked to behaviour. This implies that there is always an intention to act, before action is taken.

Many repetitive, manual tasks can, however, be carried out in 'auto-pilot' without conscious thought. The requirement for an intent to act before action also suggests that the individual has complete control over his or her actions without interference from other parties, or from other constraints such as : lack of personal capability; lack of concentration; lack of training or understanding – even fatigue. Further it implies that, in some way, the intention will be unusual and can be differentiated from 'rational' thought.

CASE STUDY ONE

At plant 1, with a 95% male work force there is no issue of wearing protective footwear in the workplace. There is 100% compliance and zero medical exemptions. Whether all individuals perceive the footwear to be beneficial or not, the compliance (or behaviour) is positive. The cost- benefit equation is weighed up, and the risk of being disciplined has led to full wearing of these shoes, leading to the modification of behaviour, and arguably a change in attitude after personal experience suggest that it may be of higher real benefit after all.

Clearly there is not always a conscious intention to act in a certain manner before action is taken, and all individuals are governed by internal and external constraints upon their behaviour. The direct link between attitude and behaviour becomes less and less clear.

The options in determining the influences on an individuals 'intention to act' are:

i) Capturing expressed attitudes or intentions.
ii) Determining the external influences in non conformance incidents and accidents that led away from this good 'intention'.
iii) Determining extent of 'control' that an individuals has over his or her actions
iv) Determining methods of addressing these attitudes, although there are difficulties in changing attitude directly.

CASE STUDY TWO :

At Plant 2, there is an altogether different situation. With a 40/ 60 female/male workforce, there are 120 individuals with 'medical exemptions' from wearing safety footwear and many others fail to comply with the compulsory wearing of protective footwear. What is the difference between these situations ? It may appear to be a case illustrating the non compliance of females in the workplace. On closer inspection, however, it is related to the aesthetic value of protective footwear. The female work force are, in general, more concerned with their appearance in the workplace and more competitive. The cause of the unsafe behaviour is not that it is of no perceived benefit, but that it does not 'look' acceptable. The strategy to deal with the non-compliance then, is clearly not to change attitudes - they already know it is safer - but to deal directly with behaviour: enforcing the rules, and offering a more sympathetic choice of styles.

However, if only unsafe behaviour or circumstances can lead to an accident, then we must focus on this - it does not matter what type of attitude the person has if there is no direct correlation between that and behaviour.

We can measure and assess behaviour by,

- ✓ Analysis of non-conformance, conformance and accidents via sampling, investigation, auditing, observation, and hazard notification.
- ✓ Determining why an unsafe act took place as opposed to a safe act – was it a lack of knowledge, information, training, due to external pressures, internal or external factors.
- ✓ Addressing these issues by implementing appropriate corrective action.

How practical are these options?

4.1.2 MEASUREMENT OF ATTITUDES

One school of thought, held by Gilby and others, believe that safety culture and attitude are always linked to behaviour (Gilby, 1996). Lee (1995) states that 'all changes in attitudes, by definition, should result in changed patterns of behaviour'. This builds on an assumption that an individual has constant attitudes with circumstance that lead directly to related behaviour. It also implies that where there is intention, there is also control and, if expressed attitude always led to a predictable behaviour, then this suggests that conscious thought must be involved.

And yet there are obvious, intuitive counters to this. Consider an individual is asked if they want to do a bungee jump, they say no. If, however, in the circumstances they are told that 'all the others are doing it' they may fall victim to peer pressure and actually do the jump. Here the expressed attitude says it is unsafe, but behaviour is the performance of the jump. Another individual asked as part of a group may initially say 'yes', but when the day for the jump arrives they may not do the bungee jump. The converse applies, the expressed attitude is yes, but the behaviour implies it is not safe.

Asking someone about their action in event of a *threat* is not, therefore, a valid prediction of what they would do in the actual situation. When faced by an actual threat/state, the expressed attitude (held beforehand) may be dismissed, leading to different behaviour at the time. The threat may be physical, imagined or emotional where the last category includes loss of social 'face'.

It has been suggested that attitudes are very much based on (Atkinson 1993; Glendon 1995)

i) Learning through experience of similar events
ii) Clusters of consistency - that is, based on past expressions or past behaviour.
iii) Factors specific to an object or situation.

Attitudes to health and safety may then be specific to work areas, social situations or risk and this is most obvious in the wearing of safety footwear or hearing protection. Ajzen and Fishbein concluded in their 1977 study (Ajzen, 1977) that behaviour can be predicted if attitudes are known, but only where the attitudes are *extremely* specific to that behaviour. Following this line, campaigns to alter attitudes should focus on specific issues rather than safety as a whole in order to avoid the difficulties of general *social* influence. A great deal has, however, been published about the ability to change attitudes from which the main conclusions relevant to this study are,

a) One cannot change deeply held beliefs (faiths) and opinions - these may remain constant over a lifetime despite disproof.
b) One can change superficial views as these change frequently according to the most recently acquired information or the present situation.
c) In between there are views, beliefs that are more or less resistant to change depending upon how they were formed and how important they are to an individual's psyche

Attitudes towards health and safety are, therefore, *contingent* ones, making it difficult to modify them unless the influencing factors are fully known and

understood. Even then there is no *direct* link between attitude held and resultant behaviour. A general health and safety poster campaign will have no impact on specific attitudes - campaigns must focus on specific risks and try to modify awareness towards a specific risk.

Attitudes may or may not, therefore, have a direct influence on behaviour in the workplace. Largely, the extent of influence of attitude on safety performance will depend upon the strength and number of internal and external pressures, firstly on an individual and secondly on a social group.

There are two sides to such a debate. Firstly, that individuals are individual and will be more or less directly influenced by external pressures according to the extent of their compliance, motivations, intelligence, background and other individual differences. A more compliant person will be more influenced by peer pressure than a non compliant individual. Secondly, the social group will have norms of attitude (and of certain behaviours). Not all individuals within the group will agree with, or comply with the group norms, but depending upon internal factors such as age, background, education and other characteristics, they may be more or less inclined to do so. So, when measuring attitude, is it more accurate to determine the attitude of individuals or that of a peer social/ work group?

When dealing with individuals in isolation, their personal attitude to safety will be influenced by personal factors such as experience and background. An individual may be able to coherently explain why they have a certain attitude, and this may directly lead to foreseeable behaviour as a result. For example, if you asked an individual why he or she smokes they will be able to explain or justify the reason for doing so, even if there is cognitive dissonance. Alternatively, if one was to ask them what they thought of protective safety footwear, they would likely comment that it was a good idea. Individuals, however, do not operate in isolation. They also form part of a social or work group, and individual views will be influenced by these external influences.

Thus, the individual smoker may say that (s)he smokes 'even though it is unhealthy', but in a group situation he may be more defensive and state that it is 'my choice and nothing to do with anyone else'. In the case of the safety footwear, the individual may state that 'it is a good idea but it uncomfortable' and, therefore, it is not worn. Closer analysis may show that in a workplace with a high proportion of women, protective safety footwear is seen as unattractive and is not worn for aesthetic reasons.

This can be summarised as:

Individual attitude: positive	**Group pressure: negative**	**Effect on behaviour ?**
'footwear is a good idea'	'it looks out of place with others'	To wear or not to wear? Strongly mediated by the involvement/integration with the group

One very critical thing to note is that although individuals in a work situation *cannot* operate in a completely independent way because they will be influenced by others, their behaviour is still independent.

The measurement of a *group attitude* towards *specific* safety issues may be a more accurate predictor of safety behaviour than any expressed individual preference. This largely depends upon strength of leadership, extent of group compliance, type of group, management, cohesion of group (Asch, 1958) and affiliations, education and many other factors.

It may, therefore, be valuable to, determine the strength of a social group in terms of the above as an indicator of the extent of group pressure and strength of cohesion to norms and identify if the group norm is strong or weak - that is, whether the individual has less or more power to make individual decisions without peer pressure

4.1.2.1 Case One : Group with Strong Norms

Here we need to measure the group 'norms' towards safety issues. The more specific the issue, such as hearing protection, the more accurately it should predict behaviour. For example, we should measure attitudes as a group together rather than individuals being assessed independently. The results may give a strong indication of expressed attitude whilst actually functioning as a group, and may also indicate in some cases the likely behaviour. On the other hand, the results have to be treated with a degree of scepticism as there is no definitive evidence that the individuals displaying such attitudes in a group situation are either temporarily or permanently complying with group norms. If this compliance is temporary for the group situation, the individual will act on his or her own initiative when alone and knowledge of group attitude will not be of benefit in the prediction of unsafe behaviour.

4.1.2.2 Case Two : Group with Weak Norm

Here we need to measure individual attitudes to a specific safety issue as the group norm will not have the same influence over the actual attitude and behaviour of individuals. That is, we measure attitudes as individuals. The problem with this is that it is not known when external factors, such as a manager or the group, *are* going to have influence and there are also factors internal to the individual, such as *motivation,* which may change over time.

It should now be clear that measuring attitude is more complex, perhaps, than observing behaviour, and the actual benefit of doing so is probably negligible. The benefits of determining social/work groups - their extent of influence and group norms (if any) has, however, other uses. The knowledge could be used to 'know thy enemy'' in that training can be specific against incorrect group norms or beliefs, can attempt to influence the group leader as a means of influencing the group and can encourage active participation of a group.

It is reasonable to surmise that if a group has cohesion and there is a strong group norm of attitude and behaviour, then an individual who goes against this will be chastised by the group internally, without interference by the supervisor or safety

personnel and this may be active or passive *correction.* A classic example would be a social group of friends who drink together but strongly believe that drink driving is unacceptable under any circumstances. A member of the social group who then attempts to drink drive is likely to be subject to heavy pressure. If the individual actually drink drives, the others in the group may ostracise the individual. In many cases, it is the fear of being ostracised that is influential enough to prevent non-compliant (with the group) behaviour in the first place.

4.1.3 MEASUREMENT OF BEHAVIOUR

It would be interesting to measure attitudes, but we have concluded that they will not necessarily indicate an improved or reduced safety performance, so let us focus on safety behaviour.

If one investigates an accident, the investigation will reveal the non-conformance that led to the accident. By focusing on the near miss or error aspect of a non-conformance, we can perhaps capture information before an accident has actually taken place. Naively we could state that, if effective, comprehensive safe systems of work and training are in place, and if an individual conforms to these guidelines, then this behaviour will be safe and should not result in an accident. This neglects, however, the difficulty that certain work practices may normally be safe but may in certain conditions become unsafe.

However, it is difficult to consider all possibilities that may occur, therefore it is most likely that accidents will occur when an operator has to react to conditions that have changed from normal and is not aware of the correct action to take. Very detailed procedures cannot cope with changed or changing circumstances, but the more open to interpretation that they are, the more reliance there is on operator 'awareness'. For a very hazardous task, such as entry to confined spaces, the safe system of work should be very precise; for normal operations, the safe system will be more general.

Pragmatically, one should dismiss attitude towards safety issues in the workplace as an irrelevant topic or at least one that is not influential in focusing improvement of safety performance. Attitude or awareness may still be measured at infrequent intervals. Focus instead should be on the modification of safety related behaviour through a series of stages. People clearly do not want to have accidents and hurt themselves, this would not be human. However, it is possible that for a variety of different reasons people are either unaware that their behaviour may result in an injury or, that they are gambling and willing to take this chance (it is cost benefit decision, a shortcut), or that it is due to accident 'proneness', carelessness, laziness, lack of knowledge, habit/ luck ('I've always done it this way and I haven't been hurt before'). In addition, there may be underlying physical/cognitive aspects to an individual that makes them more likely than others to be involved in certain types of accident. Whatever the cause of the incorrect or uninformed thought that led to unsafe behaviour, it is only the behaviour (action or omission) that can lead to an accident, whether this results in an injury or not.

It does not matter how positive an expressed attitude is, this does not indicate or remove the possibility of negative behaviour. Focus should be on modification of behaviour whilst improving education and awareness.

Therefore, the focus on modification of behaviour should be to,

i) Identify the risks from incorrect behaviour.

ii) Eliminate the chance of faulty behaviour occurring by removing the dangerous component, equipment, vehicle, substance.

iii) Implement physical control to prevent the behaviour happening. This aims to modify behaviour so that the individual will not behave in an unsafe manner, such as using ergonomically designed equipment, controls and information.

iv) Produce physical control to prevent harm if behaviour is faulty- such as machinery guarding.

v) Monitor accident data, audit and observation results to determine where faulty behaviour has occurred and how it should be modified.

4.1.4 DISCUSSION

Research suggests that there are only tenuous links between attitude intention to act and the action itself (Ajzen, 1977). It suggests that expressed attitude in general cannot be treated as an accurate indicator or predictor of behaviour (Sutherland, 1993). Most people have a positive attitude towards safety in the workplace and yet accidents due to a breach of safety rules happen. After all who would actually like to be involved in an accident that may lead to injury, pain, suffering or financial loss ? It is fair to say that attitude to safety will often be positive, but that both internal and external factors will influence an individual's intentions to act.

Table 16

INTERNAL FACTORS	EXTERNAL FACTORS
Internal factors for each individual that may affect attitude: specific situation, social background, education, class, intelligence, experience, motivation, personality, accident-proneness, extroversion, gender, carelessness, awareness. These will be the primary influences when an individual acts independently of others and is unaffected by the attitude of others. It should be remembered that in a work environment there is constant interaction between personnel.	External factors that may influence attitude include : management or supervision, group 'leader', group norm or peer pressure. Most individuals will be affected to some extent by the influence of external parties in the workplace. It would, however, be inaccurate to focus on behaviour in the workplace, treating employees purely as independent individuals, when they are in fact influenced by their interaction with others.

In fact, the theory of reasoned action (Ajzen, 1991) proposes that there are a number of complex processes influencing attitudes and behaviour including individual perception of a risk or situation, understanding of the group norm, subjective norm. These influence the relative importance of these attitudinal and normative factors for that individual and therefore his or her intention to behave in a certain manner, and all of these influence the resulting behaviour.

Alternatively, the measurement of behaviour will not be an accurate indication of attitude either. It is possible that cognitive dissonance exists within the individual, that is, the person acts unsafely and realises the behaviour to be unsafe. For example, almost all smokers understand the risks of smoking to their long-term health but smoke anyway. Some reasons for this may be that they are influenced by their peer group, they are truly addicted, or that they believe the immediate benefits outweigh the longer term costs. In a work context, an individual may be heavily influenced by the behaviour of his or her colleagues who are not wearing PPE - she realises PPE is for a good reason but that wearing it leaves her open to ridicule. Another example would be an individual who takes a short cut in a job at risk of injury, to create time for relaxing after the task has been complete.

Experience in a real industrial setting suggests that the best guide to current behaviour is past action.

The author's experience in a real industrial setting suggests that the best guide to current behaviour is past action. For example, if failure to wear safety equipment is detected – even failure that resulted in an accident, it is likely that there will still be failure to wear safety equipment. It may take a serious personal experience to change this behaviour.

It may be relevant to measure both attitude and behaviour in the workplace, but it is not accurate to say that an improved 'attitude' to safety will lead directly to an improved behaviour towards safety. It is the integration of attitude with circumstances that leads to the outcome and because there may be varying attitudes for different circumstances, the outcome will appear unpredictable. In any event, it is the *behaviour* that results in unsafe actions which lead to errors, accidents or near-miss situations. That is, behaviour has a visible effect, and that is the very reason that it is measurable.

So, if attitude is not an accurate predictor of behaviour and behaviour cannot necessarily be used to establish attitude, what can be measured?

If group norms of cohesive groups can be influenced, then perhaps group behaviour can be influenced through changing awareness. A possible solution to this may be to,

- Determine a social group, its norms and its leaders
- Involve the leader in the development of training or an awareness session
- Train the social group *as a group* in attempt to gain influence through it's leaders and to raise awareness through this individual
- Feed back to this social group as a group.

Instead of trying to fragment the social group, this can be used as a strength. The cohesion of a group may be used to your advantage by changing the social norm in a constructive way. This is usually called team building and suffers from many problems as well as advantages. First, teams are hard to form, but once formed resist change, resist outside influence and have a 'shelf life' before stagnation. They must be managed and subject to careful overview. In the workplace, team building is used but impacts on safety – good and bad have not been assessed. In so far as teams can improve productivity and innovation, it is likely that they can also improve safety – if used with care.

The other positive use of attitudes and measures of human factors is by influencing awareness. One can attempt to raise awareness and understanding of safety issues through training, and establish whether the level of understanding has increased. Experience at J&B shows that there is a direct link between an increased awareness, knowledge and understanding of a risk and the behavioural reaction to it.

Broad based 'attitudinal' studies, therefore, are of little real benefit in improving safety performance. Such studies should instead focus on knowledge, understanding, awareness of safety issues rather than on the measurement of attitude itself.

Having said this, one of the more interesting questions about individuals is whether there are people who are not susceptible to this group normalisation whether they are out of the group because of personality factors or because they are, for whatever, reason attract risk – that is they are *accident prone.*

4.2 ACCIDENT PRONENESS AND FACTORS AFFECTING INDIVIDUAL RISK

4.2.1 INTRODUCTION

This is an interesting subject because there exists research that finds quite categorically that accident prone individuals or personalities do not exist (Hale, 1987). On the one hand, some employees have accidents on a regular basis, other employees may only have one in a working lifetime, and many will never have an accident in the work place.

From the outset, one could argue that employees are exposed to different levels of risk. The risk to a machine operator or a maintenance technician will be significantly higher than the risk to an administrator. However, when comparing like employees to like by occupation and location, there is still a significant difference between employees.

Glendon and Hale (1995), for example, explained the concept of 'accident proneness' as having two major factors and observed that,

1) People exposed to equivalent hazards do not have equal numbers of accidents
2) Observed differences in personal accident experience result from enduring personal differences.

The difference between the accident experience of comparable employees may be due to single or combined factors.

4.2.2 FACTORS INFLUENCING ACCIDENT EXPERIENCE

A variety of factors may influence accident experience. These can be separated into internal factors and external factors. Internal factors are those that relate to the personality and characteristics of the individual. External factors may be outwith the individuals control, but less likely to affect one individual only. An indication of specific external influencing factors would be a cluster of individuals in a specific workplace having unusually high levels of accidents. These might be reinforced by other indicators such as high levels of absenteeism, or poor work performance.

Here we do not cover the wide range of external factors that might influence individual behaviour and actions described by Whalley (1991) and others, but we do cover the principal, classes of factors that are not internal to an individuals personality and that are relevant to the J&B sites as a whole. We are trying to separate out the factors that are not influencing an *accident prone* individual.

4.2.2.1 External factors

The following external factors may influence accident experience in a plant or firm.

1 Levels of Overtime – show me the money

An extended shift on a regular basis may create additional problems of fatigue, stress, and a lack of concentration. Individuals who have been working excessive amounts of overtime may have more minor accidents. Grouped here are fatigue, boredom, familiarity and an effect that is not often recognised – that is relaxation (for paid overtime at least) when there is a feeling that it is not real work!!.

2 Time of day – the *siesta* effect

Accidents may occur at different times of the day due to the effects of tiredness, or haste to complete a task before the end of a shift. A serious accident occurred at Strathleven when a contractor fell off ladder whilst taking a shortcut at 4.30 pm one afternoon. Accidents often occur due to a lack of concentration early in the morning or just before breaks and there are clear effects on human abilities at different times of day (Smith, 1992)

3 Resource issues – work pressure

There may be particular resource problems in certain areas due to the nature of work requiring specific skills where work pressure exists. Employees in this area may be under a great deal of pressure compared to those in other areas, and this stress may lead to higher accident experience. Multi-skilling may lead to such pressure if an important skill is not well understood.

4 Location of work – working environment

The workplace itself may create additional risks to the individuals who work there due to the specific nature of the working environment. This external factor can

clearly be controlled to some extent by the company itself, but it may not be possible to change the situation at reasonable cost.

5 Increased production – speed of work

There may be, for example, a greater number of cases produced per man hour than there was in a previous period. It may be the case that people have less time for conscious thought and action, they start to react instinctively. Unless there is the sufficient knowledge and understanding at a subconscious level, perhaps through training, accidents may be more likely to happen.

6 Reporting of accidents – a confusing factor

It may be more likely that accidents are reported in areas with a safety aware manager, or in areas that are close to a medical room. In more outlying areas of a plant only the more serious accidents are reported. This can in part explain the difference in 'reported' experience in J&B's *Unit One* as opposed to *Case Goods* - there may not actually be as wide a difference. Often there is a lack of consistency in accident reporting on site.

7 Manager/ supervisor – leading by example (or not)

Certain managers or supervisors may apply pressure to their team to achieve results at a certain speed, and by a certain time, and in some cases there will be pressure to work unsafely. Others may strongly encourage or place priority on safe working – although this has not been observed or isolated in J&B!

8 Discipline or threat of discipline – control of habit

The threat of disciplinary action - whether formal or informal - can be used to coerce individuals to follow rules (whether work practices or safe systems of work) and will affect safety behaviour.

9 Group Norm – influence by the work group

The influence of the working group and the group norm may impact upon the attitude and behaviour of an individual.

10 Systems – written and real procedures

There may be inadequate or incorrect safe systems of work that relate to specific

work tasks. These work tasks may be carried out by one individual only, or a group of individuals.

All of the factors discussed above - with the exception of safe systems of work - would affect all of the individuals in a particular location or area or occupation. A group of individuals will have the same manager, working the same shift, the same level of overtime, under the same extent of pressure to produce, in the same location and tasks, with the same group norms. So, if the external factors exist at the same level for all individuals in a certain work location and task, then this leaves only the *internal* factors. The personalities of *individuals,* and their individual differences - that will cause them to experience different rates of accidents.

4.2.2.2 Internal and personality factors

There are a variety of internal factors that can influence safety behaviour :

1 Carelessness – *oops!*

Some individuals may be more careless or pay less attention to detail than others, which may lead directly to a higher accident experience.

2 Awareness – I didn't know it was loaded.

Repeated accident experience may be due to a lack of awareness or the wrong 'attitude'. An actual attitude is very difficult to define, and even harder to accurately measure. It is also very difficult to compare individuals in the same work area as their *expressed* attitude may be unilaterally positive, but certain individuals will still act unsafely. The level of *awareness* or *understanding* of a task, the related risks and the safe systems of work may be more useful in understanding accident experience.

3 Capability – just naturally uncoordinated.

The physical capability to actually perform task. Some individuals may perform tasks that cannot be or are not adjusted to suit them ergonomically, as a result of which they struggle to lift items and pick up physical strains; muscular and back injuries.

4 Training – limited ability to extend knowledge to *upset* conditions

Certain individuals seem to be unable to translate their current knowledge and training to enable them to react correctly to situations outwith the ordinary, thereby creating potential accident situations.

5 Intelligence – IQ or *"g"* factor

The loose term of 'intelligence' may impact safety performance. In this case, intelligence could be defined as the ability to process and act on information. It is suggested by research that more 'intelligent' people are more likely to make mistakes in repetitive tasks, but less likely to have mistakes in tasks requiring skill and precision.

6 Extroversion – look at what I can do.

It has been suggested that extroverts are more likely to have accidents in tasks which require premeditation and analysis beforehand (Powell, 1971). Extroverts have a tendency to be risk seekers rather than risk averse, searching for additional experiences. It has also been suggested that extroverts report accidents more readily than introverts, therefore biasing accident experience figures.

7 Gender – vive *la difference!*

It has been *suggested* that there are differences between the way in which males and females behave, therefore creating a difference in accident experience.

8 Age – experience versus ability

There is debate about whether age has an affect on accident experience. It is suggested that younger people have more accidents, reducing with age and therefore experience, until physical capabilities are gradually reduced at older age. Although older people have a tendency to be more cautious and experienced, they will eventually have reduced visual and psychomotor skills.

9 Aggression – Oh for God's sake give it to me!

It has been suggested that more aggressive individuals are less willing to suffer the inconvenience of taking adequate safety precautions, therefore displaying risk seeking behaviour. As a consequence of this, aggressive individuals are more likely to have accidents than passive ones.

10 Anxiety and neuroticism – did you switch all the lights off and lock the door?

Anxiety, worry and neurotic behaviour can lead to considerable importance being placed on the checking of environment, circumstances and of actions taken. This behaviour may reduce the likelihood of unsafe behaviour, and therefore, accidents.

11 Psychomotor and visual skills - 3D Spatial awareness

Individuals have varying levels of skills relating to perception, which can affect their action in the working environment. Even at a basic level, an individual who is short sighted but does not wear glasses will be more likely to have accidents than an individual with normal eyesight, if the task requires this skill for it to be performed safely and correctly.

12 Attention and concentration – sorry, I missed that.

Those individuals who have a higher level of concentration and attention to a task or situation, will be less likely to have accidents than those with a limited concentration span. This may be especially true of 'slips' where an action is performed wrongly because of distraction.

13 Life Events - sad or happy

Although 'life events' are specific to each individual, they are often created by an external party or parties or an external set of circumstances. Each individual has a range of coping mechanisms and, due to these individual differences their ability to cope with major life events will differ widely. Major life events have been associated with an increased accident rate in a number of studies (Selzer, 1974). Those individuals who have better coping mechanisms will be less affected in terms of an increased accident experience.

14 Compliance – are you sure it'll be OK?

Individuals who are compliant or passive are more likely to feel pressurised to follow rules, and other orders given by the manager or others in the group, whether this is to take safety precautions or discard them. Such an individual is also more likely to comply with the views and behaviour of the natural group leader and group norm, in some cases creating a conflict with the requirements of the manager. A compliant individual is more likely to diverge in behaviour from his or her expressed

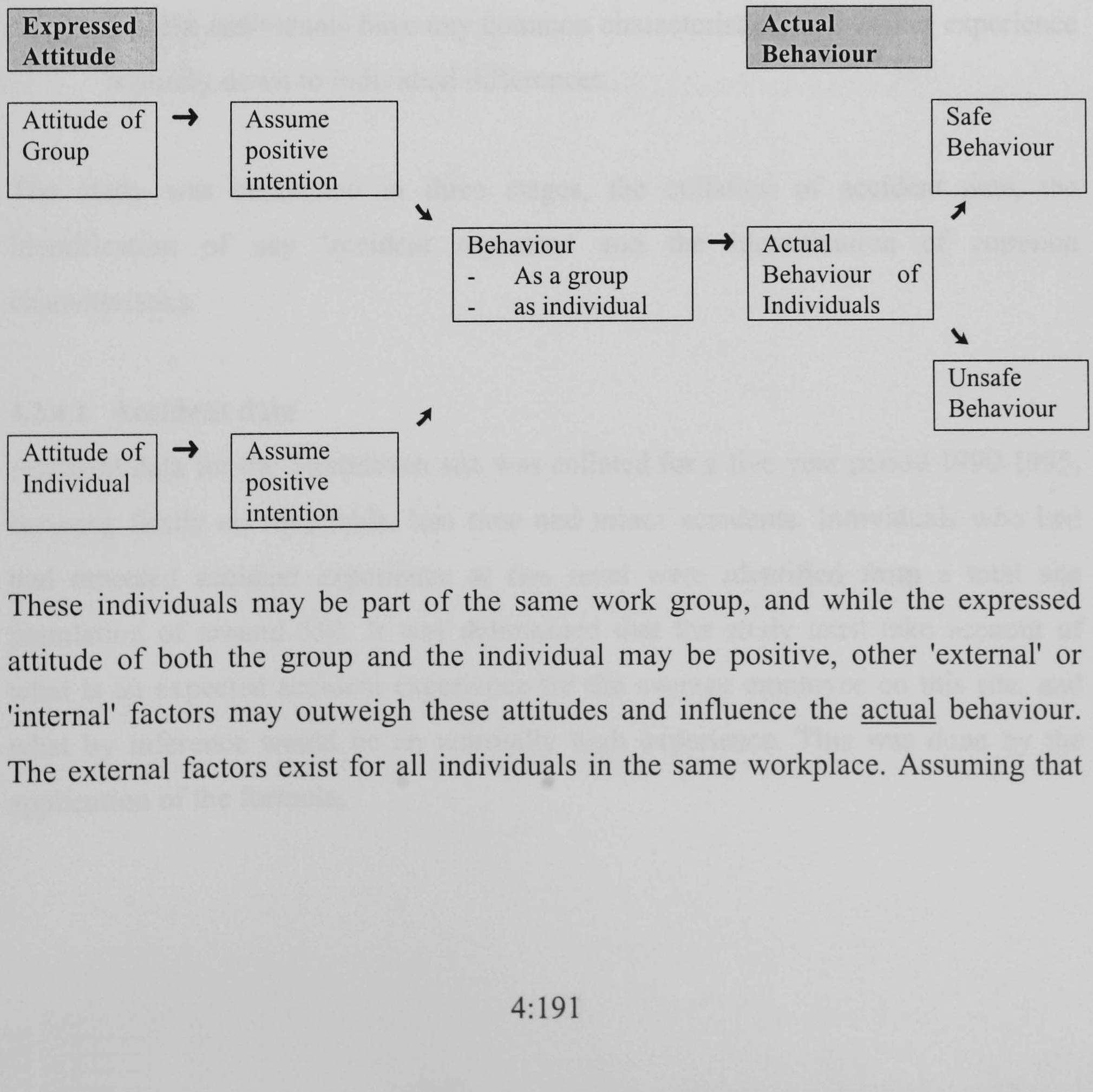
attitude, due to the views and behaviour of others, than a non-compliant individual. This type of individual may have more or less accident experience than would otherwise be expected depending upon whom he or she is complying with.

4.2.3 ACCIDENT PRONENESS

In a work environment, individuals may be highly influenced by group dynamics and by group norms. An individual's attitude will be formed by the joint influences of his or her personality and the behaviour/attitudes of the group. That is, his or her expressed attitudes will be formed in this way. However, as discussed before, the linkage and influences between *expressed attitude* and *actual* behaviour, if they exist at all, are not only tenuous but also extremely complex.

Assuming that an expressed attitude is *intended* by an individual to describe his or her intended behaviour, the model shows that although individuals may have the same intention, their actual behaviour may differ.

Table 17



These individuals may be part of the same work group, and while the expressed attitude of both the group and the individual may be positive, other 'external' or 'internal' factors may outweigh these attitudes and influence the actual behaviour. The external factors exist for all individuals in the same workplace. Assuming that

this is the case, there is no explanation for the fact that individuals have varying levels of accident experience, some never having had an accident, and at the other extreme, some who have had a high accident experience, in a comparable set of circumstances. Different levels of accident experience in a work place therefore must relate, at least in part, to individual differences. This directly disputes the theory that by modifying a group attitude to safety, one will then directly modify the risk taking behaviour and accident experience of these individuals in the workplace.

It is suggested then that it is not necessarily an inaccurate or negative 'expressed' attitude to safety that leads directly to risk taking behaviour in the first place, and second, that due to individual differences, some people are more prone to having accidents than others, who would otherwise be in a comparable situation.

4.2.4 ACCIDENT REPEATER CASE STUDY

This study aimed to determine,

1 If people exposed to equivalent hazards on site have equal numbers of accidents

2 If there are individuals on site that can be considered to be accident repeaters

3 If these individuals have any common characteristics, or whether experience is purely down to individual differences.

The study was conducted in three stages, the collation of accident data, the identification of any 'accident repeaters' and the identification of common characteristics.

4.2.4.1 Accident data

Accident data for the Strathleven site was collated for a five year period 1990-1995, focusing firstly on reportable, lost time and minor accidents. Individuals who had had repeated accident experience at this level were identified from a total site population of around 550. It was determined that the study must take account of what is an expected accident experience for the average employee on this site, and what by inference would be an unusually high experience. This was done by the application of the formula,

$$\lambda = \frac{\text{Total no of lost time/ minor accidents in five year period}}{\text{Average number of employees}}$$

Table 18

Year	Total Accidents	No of Employees
1990/1	116	600
1991/2	133	580
1992/3	121	580
1993/4	121	580
1994/5	107	550

Giving a λ of 1.0346, the average number of reportable or minor accidents per person in a five year period, at the Strathleven site.

In principle, given this base occurrence rate, the probability of any individual having *X* accidents in the five years would be,

Table 19

Number of accidents	Probability of occurrence
2	0.19
3	0.068
4	0.0176
5	$3.64*10^{-3}$
6	$6.28*10^{-4}$
7	$9.28*10^{-5}$
8	$1.20*10^{-5}$

For comparison the odds on winning the lottery with one ticket at each draw are $2*10^{-8}$ so having 8 or more accidents is obviously possible! In this study, however, we have accepted that a value of $1*10^{-4}$ is a reasonable cut-off for unlikely events.

The accident data was analysed again and only those individuals with accident experience of 5 or more accidents were plotted into a database, noting that the

probability of any individual having 5 or more accidents in this 5 year period is 3 in 1000.

There were a total of 13 employees out of a work force of approximately 550 that had accident experience of 5 or more accidents in a 5 year period. Even at 7 or more accidents, with a probability of $9.28*10^{-5}$, there are 4 individuals. These individuals and others were then analysed for experience of first aid accidents and this experience was plotted in a database for analysis.

4.2.4.2 Identification of accident repeaters

From the study of the work force, therefore, it was determined that 13 individuals could be identified who had had 5 or more minor or reportable accidents, in a period of five years. These were examined in more detail,

Table 20

Case Number	Reportables	Minors	Sub-total M & R	First Aid	Total Accidents
1	1	5	6	2	8
2	1	5	6	7	13
3	0	5	5	2	7
4	0	5	5	0	5
5	0	5	5	7	12
6	0	5	5	3	8
7	0	5	5	4	9
8	0	6	6	21	27
9	0	6	6	6	12
10	0	7	7	13	20
11	0	8	8	5	13
12	2	10	12	4	16
13	0	12	12	4	14

It would seem that there is at least some evidence for at least 4 accident repeaters, who have had between 7 and 12 minor and reportable accidents each in this period – considerably more if first aid events are included. The 13 highlighted individuals also had a total of 87 first aid accidents between them in this five year period.

Incorporation of first aid events would however create another issue as the first aid accident data is statistically unstable, as discussed in the earlier statistics chapter. However, as an example, Case 8 had 6 minor accidents, but also had 21 first aid accidents, that is an overall total of 27 accidents. As previously discussed, first aid accidents can be skewed by an individual's area of work. Those individuals who work near the Medical room will appear to have had more first aid accidents, but experience suggest this is more likely to be an effect from more accurate reporting. Due to the inconsistency of first aid figures, only minor and reportable accidents were used as indicators.

Certainly, the probability of having more than 7 accidents is very low at $9.28*10^{-5}$ and, therefore, the history of these individuals was examined. All four worked in different areas in the plant. Cases 11, 12 and 13, however, all worked in bottling areas on the site although in different units, so they would have different external factors in terms of location, tasks, manager etc, but they would share these external factors with others in their own area - there may be up to 50-200 other employees in each of their units who are influenced by the same external factors. Clearly, there are wide differences in the number of accidents that employees in these areas have, when the risk exposure is the same.

There is, therefore, evidence that these Cases 10, 11, 12 and 13 qualify under Glendon and Hale's definition of accident repeater or accident prone.

4.2.4.3 Case studies

Cases 10 and 11 both worked in the main bottling area - Units One and Two, but their experience was rather different. The accessibility of the nurse for all employees in this area leads to a high level of reporting. Both Cases had similar numbers of minor accidents, but case 10 reported a far greater number of first aid accidents.

The accident rate was proportionately higher in these Units compared to elsewhere on site - due to the nature of the work. However, there are many different external factors - there were no clusters on particular lines within the Units. In addition, there were another 14 employees with more than 3 accidents in this 5 year period. Although there were around 200 employees in Units One and Two, only 2 had had more than 7 accidents in the last 5 years. This suggests individual factors.

Case 12 worked in Unit 3, with a total of 12 minor or reportable accidents and several reported first aid accidents. First of all we examined if there was a cluster of employees in this area with a similar accident experience, to identify if it was job or task factors, managerial factors, location, or any other common external pressures.

There were another 4 employees who had had 2 minor accidents each, but this could be expected (statistically) in an area where 50 employees work, over 5 years. There was little evidence of a cluster of bad experience in this area, which discounted external factors, leaving only internal factors to account for the difference in accident experience.

Case 13 worked in the Palletiser area and had 12 minor accidents in a period of 5 years and several reported first aid accidents. There were no other employees based in this area who are listed on the database top 30. However, it has to be mentioned that the Engineers in this area said that ' small accidents like cuts are part of the job' and stated that they would not go to the nurse to report it. It is also true that the Pallestiser is positioned far from the Medical Room. It is still true, however, that there were no other employees from this area listed, so why this employee? The answer, even if it is only that certain personalities report accidents, must be due to individual characteristics.

4.2.4.4 Common characteristics of accident repeaters

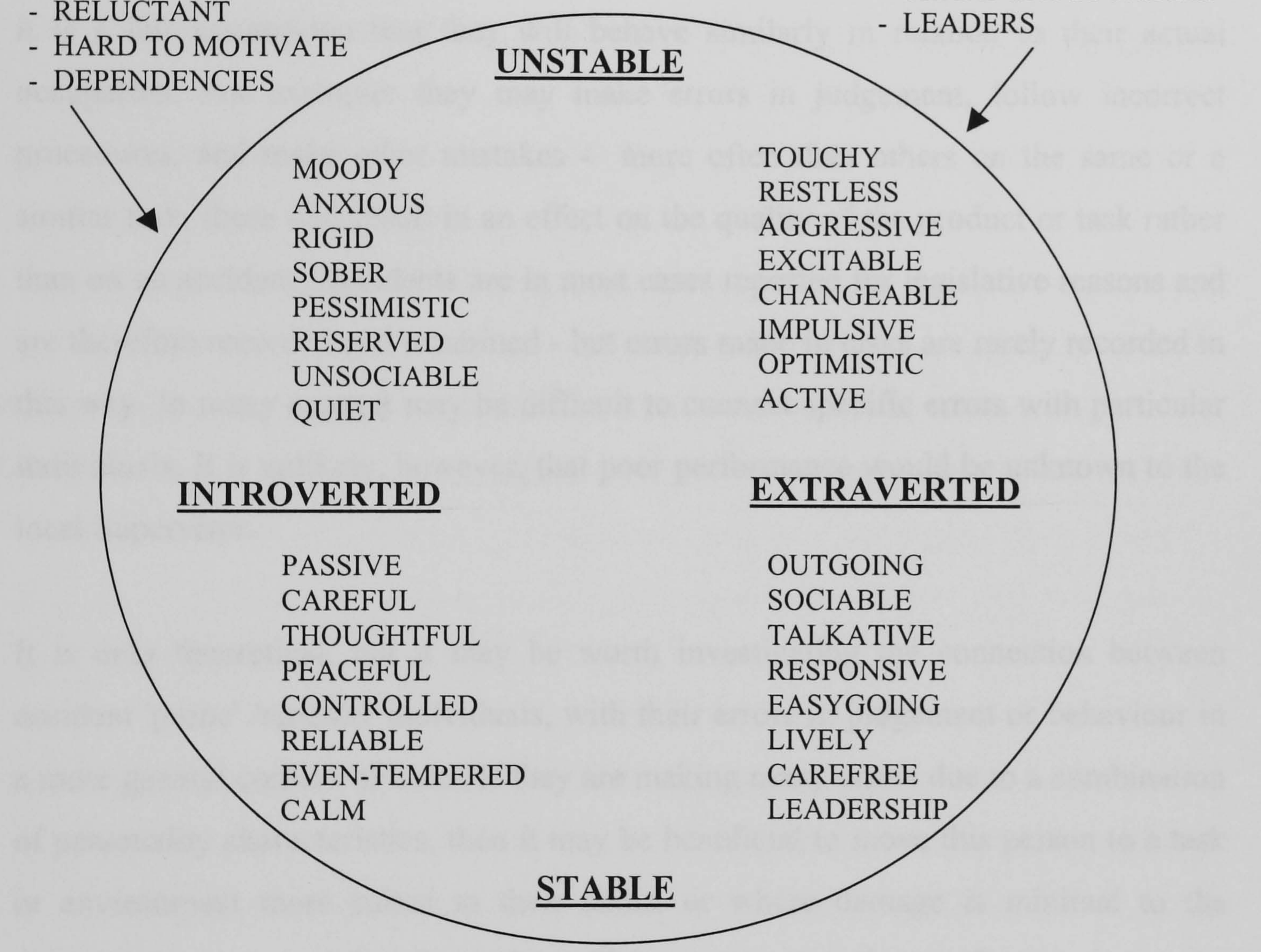
Other research studies have failed to identify an 'accident prone' personality trait or 'gene'. The identification of such a personality trait is outwith the scope of this study, but it is interesting to discover if there are common characteristics shared by the 4 ‘main’ accident repeaters.

It has been argued in other studies such as Selzer and Vinokur (1974), that temporary stressors or major life events are a main cause of high accident rates. In fact Porter (1988) suggests that an accident proneness is not a constant *trait* of an individual, instead it is dependant upon circumstances and events. However, in this study, all four of the accident repeaters have had a continued high level experience over a five year period. The effect of major life events cannot be discounted, but should not be responsible for continued accident experience at this level over such an extended period of time.

Several parties have proposed characteristics or traits of individuals who are prone to accidents. The Shaw Sichel model (1971), that appears to be based on original material by Eysenck (1964), is below modified to attempt a prediction of accident repeaters based on J&B staff.

Table 21

Proposed Model of an 'accident repeater'



The conclusion from J&B experience is that accident repeaters do exist and, moreover, they exist in some quantity – at least 1 in 100 and, perhaps, more. Even more alarming is the fact that this does not include those who might deliberately seek to harm others.

4.2.4.5 Effect of accident repeaters

The Shaw Sichel model suggests that the common characteristics of people who have had repeated accident experience include poor attention, extroversion and over confidence. If these individuals have accidents because of their internal and personality factors, then it is also fair to assume that generally their behaviour will fail to conform with procedures. In a safety context, even when there is non conforming behaviour, the circumstances must also combine to allow a serious accident to happen, otherwise the individuals may have a hidden record of 'near' misses.

If individuals do not pay attention to safety precautions, or fail to follow them, then it is a fair assumption that they will behave similarly in relation to their actual occupation. For example: they may make errors in judgement, follow incorrect procedures, and make other mistakes - more often than others on the same or a similar task, these will result in an effect on the quality of the product or task rather than on an accident. Accidents are in most cases reported for legislative reasons and are therefore recorded and examined - but errors made in tasks are rarely recorded in this way. In many cases it may be difficult to connect specific errors with particular individuals. It is unlikely, however, that poor performance would be unknown to the local Supervisor.

It is only theoretical, but it may be worth investigating the connection between accident 'prone' /repeater individuals, with their errors in judgement or behaviour in a more general context of tasks. If they are making many errors due to a combination of personality characteristics, then it may be beneficial to move this person to a task or environment more suited to their skills, or where damage is minimal to the production process, and to themselves. If the errors are task specific then it may be an issue of capability, training or reskilling. This study could be extended to evaluate the general performance of the 13 cases listed in the table, to determine if there was a direct association between accident performance and production or quality performance. If characteristics linked to general errors could be identified, they could be built into the recruitment process.

A critical issue is that when a company aims for zero defects within the production process, these scattered individuals may have an impact on otherwise improved results. This is certainly the case with the accident statistics at J&B Scotland because, as they reduce annually, the poor experience of a relative few is having an impact on the overall figures. The critical difference between safety and quality, is that while there are humans in a plant, there will never be zero accidents, but zero defects is theoretically possible within a quality environment. Therefore, it is possible that, due to their personality characteristics, a minority of error prone individuals may have a major impact on the satisfaction of the customer, both internal or external. The impact of this may be very wide ranging indeed in a competitive, quality and customer related market place.

4.3 PEOPLE AND PARTICIPATION

4.3.1 INTRODUCTION

The previous two sections have suggested that the focus for improvement of health and safety performance should be upon behaviour, awareness and understanding rather than on 'attitude' to safety. There does not appear to be a conclusive link between attitude and behaviour, and in addition there are impacts due to individual differences. In essence, even if you have ensured that employees have a positive attitude to safety, safe behaviour does not necessarily follow and it cannot be guaranteed that no errors will result.

So what then can be done to improve standards of safety, and how can safe behaviour be achieved ? It has been a strong thread of belief throughout this study that improvement could not be achieved without the active participation of people at all levels within the company. A multi-faceted approach was required to ensure effective involvement.

4.3.2 SAFETY CO-ORDINATORS

4.3.2.1 General

In J&B, safety co-ordinators were appointed from middle management at the Strathleven site in the early years of the study (1995/6) based on recommendations in the University study, the outcome of the first CHASE audit and consideration of effective mechanisms. They were all Line Managers, and from a range of departments covering the whole site – Production, Back shift, Warehousing, Spirit Supply and Laboratories.

They were appointed as an interim step. It was recognised that ideally all Line Managers should take full responsibility for occupational health and safety in their own area, but that they required the skills to manage this effectively. This would take time.

An additional reason for their appointment was that the current health and safety manager was retiring after around 18 years service. A decision had been taken that health and safety must no longer been seen as the safety 'policeman's' responsibility, and it should instead be placed fairly and squarely with each and every individual on site. It was decided that, as Managers had responsibility for their sub-ordinates, they should be trained to supervise safe operations whilst ensuring that their team took full responsibility for their individual actions. The interim step ensured that 5 Managers had the skills and expertise combined with local knowledge.

It was recognised however that the Managers did not all have the necessary skills to perform the role as competent person, and so an interim stage would be required. The Safety Co-ordinators were sent on examinable NEBOSH Certificate courses, and attended specific safety training to match their departmental risk profile. The site was then split into 6 main areas with a Safety Co-ordinator responsible for each, with the central Risk Function providing strategic lead and specialist support as and when required. It had been anticipated that the individuals selected as Co-ordinators would move internally over time and could take this expertise with them to another role of department. This did, in fact, occur when the Back-shift Safety Co-ordinator took up

a position as a Production Line Manager, the Warehousing Safety Co-ordinator became a Production Line Manager, and the White Spirits Safety Co-ordinator became the Process Improvement Manager. The Brown Spirits Manager shared the Co-ordinator's rôle and has eventually reached Executive level as Manager responsible for all spirit production. Initially, the Risk Department provided regular support and input to safety decisions, but this support was required less and less as the Co-ordinators grew in confidence.

4.3.2.2 Overall strategy

The overall strategy was that all Line Managers would have OHS training and competence and that safety should be managed 'on the line by the line'. There had to be a gradual change from centrally managed safety. It was planned that the initial Co-ordinators would first settle into their roles, and then the Production and other line managers would be trained to NEBOSH Certificate level, this process being staggered over a period of time. These Line Managers would then be supported by the designated Co-ordinator and by the central Risk function. In practice, because of the job moves and promotions discussed above, a number of key managers now have both NEBOSH Certificate training and experience as a safety co-ordinator.

In line with the strategy, however, a custom designed *specialist* 5 day safety course for Managers and Supervisors was sponsored by J&B through the Scottish Whisky Association with RoSPA. This was intended to be an alternative to the NEBOSH Certificate as it was to be tailored to the needs of the drinks industry. As with all Industry initiatives, however, the course development was prolonged and the content diluted.

J&B also, therefore, set out to develop a more intensive and directed three day course with a specialist training provider. This became operational just as the merger (and subsequent plant closure) was announced. Executive authority had been given for all Line Managers to take this course over a twelve month period.
Although the various training schemes set out to provide managers with technical training and a better understanding and awareness, an additional benefit was clear.

Over the study period the Co-ordinators developed from neutral individuals to strongly committed advocates of safety management within the company. Although the study, therefore, did not set out to achieve a change in expressed attitude, it was achieved anyway, as well as a clear measurable change in behaviour, awareness and understanding. Indeed, during the annual audits, the Co-ordinator function has been picked out by both the external auditor and internal parties at all levels as the single most important reason for the company's strong safety management performance and improving standards. This view was repeated in the individual Interview Study.

4.3.2.3 Local tactics

Clearly, selection of the right individuals to take on the Co-ordinator function was critical. They developed strongly in their careers, but were chosen for their character and potential – a chicken and egg situation. In a people business, selection of people is critical and the Co-ordinator function had to be sold to ambitious and competent people. The selling point was career development. It was pointed out that the Company was expressing a commitment to OHS in the foreseeable future and that Occupational Health and Safety would always be seen as a positive (or at worst a neutral) item of experience in a career profile. This could be contrasted, for example, with specialist experience that offers no wider perspective and an impression of insularity. The *selling team* would appear to have been very good in both target identification and sales!! Of the five Safety Co-ordinators appointed and trained, four out of five received job promotions within three years of taking on the Co-ordinators role.

4.3.3 SAFETY COMMITTEES

4.3.3.1 Historical situation

The safety committees were seen as key to achieving involvement of people at operator level in decisions about safety management and gaining their commitment to policies. The biggest challenge was the safety committee at Strathleven, that represented the health and safety of 550-600 employees on a large single site.

Initially, in 1993, the Strathleven Safety Committee had a less than diverse representation, with the Financial Director (as Chair), the Health and Safety Manager

and Safety Representatives meeting on a monthly basis. The committee focused on day-to-day safety issues such as broken guards and other low level issues and no attention was paid to strategy and improvement of health and safety standards. Indeed, when the Chairman did not attend (and that was relatively often) only discussion took place with virtually no actions.

4.3.3.2 Change actions

A conscious decision was taken to involve the committee in progress and strategy rather than with the daily issues that could, and should be resolved at local departmental level. The safety committee members were *encouraged* to get issues resolved by notifying their manager, and raising a request form, and bringing only urgent or unresolved issues to the committee. Inappropriate issues raised at the Committee meetings were politely refused and the member directed to a more appropriate forum where the issue should be discussed and resolved. This gradually changed the focus of the safety committee.

The committee membership was then broadened to deal with its changing role for employee involvement.

At the same time and with the joint intention of developing understanding of safety management and producing cohesion in the Committees, a training course was developed by J&B with the Trade Union Training Centre at Reid Kerr College in Paisley. All members of the Committee attended – both management and workforce. Prior to this, attempts to drive trade union appointed Representatives to undertake union sponsored training had met little success – falling foul of entrenched pay and condition priorities and parochial vision. (At one meeting the author was called a ******* *liar and a manager* although there was some doubt about which was intended as the biggest insult.)

The safety committee membership at Strathleven was modified. The new Committee consisted of a new executive level chairman, the Risk Control Manager, site nurse, representatives from all Union groups, plus Safety Co-ordinators, representatives

from Facilities and the Training team. These members were specifically selected to represent the site fully.

The Executive team nominated the Quality and Blends Director as chairman. He was later replaced by the Quality Director. The changes were intended to provide strong, senior leadership and representation at Executive level at the safety committee. The Risk Control Manager provided technical strategic leadership, direction and expertise. The Safety Co-ordinators represented the 5 main geographical zones of the site, and input from a management perspective. The three Union Groups and their members were represented by Safety Representatives. In addition, as the Facilities Department were often asked to solve the physical problems raised at the committee they also had representation. Finally, the Training team were represented to provide input to the training required to help implement the strategy and the safe systems of work. Other parties appeared as 'guests' for presentations or to help resolve specific issues. The new committee represented and consulted a far wider range of individuals and had the authority to make *real* decisions at meetings.

4.3.3.3 Committee activities

Key issues were selected for the new committee to provide early focus and 'team' behaviour based on shared tasks and goals (Klause, 1996).

i) implementation of a hearing conservation programme,
ii) the No-Smoking policy,
iii) the Hazard Notification book
iv) the development of the new Safety Management system.

It has to be noted, however, that some committee members adapted to the changing rôle of the committee better than others. Most members appreciated the change to proactive safety management from the reactive, confrontational style of previous safety committees, but the new committee faced difficulties, as a minority prevented it from taking on its new direction fully. Indeed, several members still believed the committee to be a forum to air grievances against general management decisions and raise employment and pay and condition issues. With conflict of this nature, this

forum could not aim to improve safety standards in a constructive manner.

There were difficulties in the appointment of Safety Representatives as traditionally the Representatives on site had always been Union appointed (HSE, 1996b). There was opposition from an existing Safety Representative in an area where new Representatives were to be appointed. She was asked to request nominations for Safety Representatives for the area and, on her refusal to assist with the process, the other Unions were approached to provide representatives but were not forthcoming. In the end, appointments of two new Safety Representatives were made by the Line Managers (as permitted by the Employee Consultation Regulations 1996 (HSE, 1996b). The Line Managers approached keen, safety-conscious individuals and, after a short period of adjustment, the original Safety Representatives accepted their new colleagues.

4.3.3.4 Outcomes

One of the aims of the overall study was to overcome this conflict and seek the positive, constructive involvement of employees at all levels. The Safety Committee should have provided a good vehicle for this participation. A comprehensive training programme had been developed for all committee members to include : teamwork, meetings skills, and other technical safety training such as risk assessments and auditing. The training aimed to increase the skills and understanding of the safety committee members beyond the legally required standards. The membership had been changed to provide impetus and expertise.

And yet....., an element of conflict remained to the end. Most members are committed and positive members of the Team and the physical presence of a senior management chair is no longer essential as responsibility for action is taken by individual Committee members.

By 1997 a direct relationship could be observed between a positive expressed attitude to involvement, the active participation of the safety committee member, and the safety standards in their area of responsibility. This correlation was identified by

the results of the external audits, the number and type of accidents, and more simply a reduction in the number of unresolved safety issues.

4.3.4 HAZARD NOTIFICATION AND RISK ASSESSMENT

4.3.4.1 Hazard notification

The safety committee members and all employees were encouraged to use a hazard notification book. This system had been in place for several years before the period of study but had been seldom used. It was intended that any employee could draw attention to a hazard by completing a notification form, and passing a copy of the sheet to the Department Manager and another through the maintenance system for the improvement to be carried out.

It was established that many employees were not being allowed access to the books, and others were simply not using them. A Subgroup from the Safety Committee was set up to revamp and reissue a Hazard Notification system and developed a new system after consultation with employees, the Management team, and the safety committee. This was probably the first positive development by the new committee and was a direct outcome of their training course where a project was required.

The forms which were internally generated, could be completed by any employee, and were sent direct to the Facilities Team. Each hazard raised was assessed and ranked in order of risk priority and actioned accordingly. The system ensured that all risks were communicated but the system would not be abused. Actions were planned into the Planned Maintenance system, and jobs requiring improvement action were issued. Feedback was given to the individual who placed the hazard report. At the monthly safety committee, outstanding 'hazards' were discussed. The book was launched with a communications campaign that encouraged employees to raise any safety issue.

The system encouraged the participation of all employees, and added priority to issues that were not being resolved at Departmental level – in the first instance through the personal involvement of a Safety Co-ordinator and a Safety

Representative in the Facilities Team - later as part of a system. There would be further discussion at the safety committee.

Previously some of these concerns had been lost as Managers had not given employees the opportunity to raise a hazard form – perhaps taking any complaint as an implicit criticism.

The system also acted as a cost effective method of behavioural analysis. It has been commented earlier that while concentrated behavioural analysis has some benefits, these benefits could not justify the introduction of such as resource and time intensive system. In addition, specific skills and expertise would also be required but were not available within the company at that time. Hazard notification, however, allowed all employees to observe and comment on unsafe action, behaviour and situations, and demand that improvement action is carried out. The notification system required discussion of whether a hazard exists or not, and of what level of risk it represents against other hazards and this discussion provided active participation of all employees on the improvement of safety standards. It was important, however, that employees were encouraged to resolve local day to day issues at departmental level first and only to raise hazard forms for unresolved or repeated issues.

4.3.4.2 Risk assessment

Another method used was that of the risk assessment – over and above that required by the Management of Health and Safety at Work Regulations (HSE, 1992[b]).

Apart from the use of planned risk assessments for all tasks on site, additional risk assessments were carried out when a hazard was communicated to a departmental manager or Safety Representative. Risk assessments were also integrated into the equipment purchasing system. All tasks, projects or equipment with potential safety implications were risk assessed before being authorised for purchase or implementation, and the assessment was accepted by the Risk Control Manager. Indeed, in practice, all projects, tasks and equipment were approved by the Risk

Control Manager before they began, to ensure that there was involvement of a safety expert at the outset. Thus, risk and task assessments were used as a tool to improve current tasks on an ongoing basis, to justify safety improvement, to prioritise improvements to hazards and on request by any employee. The risk assessment process became integral to the identification and improvement of risk control within the company with the active involvement of employees at all levels. It enabled risks to be prioritised with key risks actioned via the Facilities Team's maintenance system to ensure that risks were not overlooked.

The risk assessments were generally carried out by the local Safety Representative (who had received training on conducting risk assessments) and Safety Co-ordinator or the Risk Control Manager.

4.3.4.3 Resistance overcome

An important issue was confronted here. Many union appointed Representatives refused to be involved in risk assessments as no additional monetary reward had been nor would be, agreed with the Unions for this involvement. The Management Regulations imply, however, that the safety representatives (and the individuals who perform the work) should be involved in any task risk assessment and there is obvious value in this. There was in addition, however, a mystique attached to risk assessment that seemed to inhibit starting the assessment. The tactic developed by the Risk Manager and the Safety Co-ordinators was to *turn up and talk* about the task thus forcing the Representative into collaboration.

4.3.5 SAFETY INSPECTIONS

At the outset of the study, safety inspections were carried out by the Safety Representatives (usually alone) on a sporadic basis, with physical inspections being carried out by the Health and Safety Manager in his policeman's role. The company policy was changed in 1995 to require Safety Representatives to carry out monthly inspections as a minimum with the Line Manager or safety co-ordinator. This complemented the approach to risk assessment. This system worked effectively where there was an adequate number of Safety Representatives in an area and a

genuine commitment by the Line manager.

The external audit in 1997 reinforced the link between safety inspections, safety standards and the effective enforcement of policies. In the areas on site where good regular inspections were carried out and improvement actions implemented, the safety standards were judged to be highest and accident rates lowest. The areas where the program was most successful combined a trained Safety Co-ordinator and a committed Safety Representative.

By contrast, a deficiency was pinpointed in one area on site where, due to organisational restructuring, there was one Safety Representative for a large area where nearly 200 employees worked. The Representative was not performing thorough, regular audits, and there was little management commitment to improvement of the inspections in the area. The safety audit had suggested these production units were deficient in safety standards and the highest in terms of frequency of accidents (although the severity of these accidents tended to be relatively low). It was clear that positive action was needed to improve these areas. The first step was to appoint additional Safety Representatives for the area, and provide them with adequate training and skills. The three production line managers agreed that they each needed a Safety Representative allowing them to build up a direct relationship with the Representative on safety issues.

The safety management system had been devised in ISO style and was intended to be audited as such, with procedures being audited both internally and externally. The next stage of the system was to audit against checklists for what was physically there, almost like a structured safety inspection. All Safety Representatives were trained to carry out audits which were intended to, in part, replace the safety inspection system. Due to the organisational changes, however, the new system never wholly replaced the original safety inspection system and it is hard to judge its merits.

4.3.6 TRAINING

4.3.6.1 Training matrix

A comprehensive system of safety training was put together to ensure that all employees received proactive training in health and safety issues. The training was put together in matrix form (see figure 16) with compulsory training and recommended training for employees in different positions in the company.

It was proposed by the Executive that all line managers receive the 5 day ROSPA accredited health and safety awareness course for managers – later replaced by the intensive J&B three day course. To supplement this training, the Managers would then receive specialist training on areas of particular concern to them - for example, *control of contractors* for the Facilities Team, *permits to work* for the Engineering Dept, *electrical safety* for the Services Co-ordinator and for Engineering.

This matrix listed mandatory courses for employees by position or trade, then specific supplementary courses for this position or trade. The safety management system requires that to perform a certain job or role, the individual must have a set of safety skills which can then be built upon and refreshed. These skills, as provided by the training course were listed in the matrix. In many ways these requirements would transfer directly into *competencies* as defined within the various *SVQ* structures. In the mid 1990's there had been a UK national initiative to set up a lead body for safety within the NVQ framework, but this was not moving quickly enough for J&B's purposes nor was it focused upon J&B's needs.

The Safety Co-ordinators were the first recipients of the NEBOSH Certificate – albeit the Certificate was not specific to the drinks industry. It was planned that future Co-ordinators and Managers would take the ROSPA accredited – later the J&B intensive – industry specific courses. All of the training listed in the matrix targets safety awareness and modification of behaviour rather than 'attitude' and there were clear examples of individuals who had clearly improved their awareness as a result of *high impact* training.

During the Management interviews, some of the Co-ordinators specifically mentioned a one-day in-house safety course for Supervisors that really hit home with the potential consequences of neglecting their responsibilities for safety. This had been intended to raise interest and awareness in the next, more detailed courses. Interestingly, both the staff and Managers mentioned in interviews a change in 'attitude' around this time which had lasting effect.

It cannot be determined whether this was indeed a change in *attitude* or a response to a stimulus, but there was certainly an observable display of different behaviour and *expressed attitude* due to increased understanding of the legal position if not of safety requirements. Either way the net effect of the improved awareness was improved safety standards due to more safety conscious Managers. It appears, therefore, that by providing even limited training that targets safety behaviour a change can be produced in understanding and behaviour.

4.3.6.2 Safety induction and recruitment

Responsibility for occupational health and safety was written into all job descriptions and job adverts from 1996. Prior to this time, OHS responsibility had only been specifically listed for roles that had a direct input into the function – that is, the OHS Specialists. An opportunity for change was seized in 1996 with the launch of the Job Evaluation Scheme. The Job Evaluation Scheme listed all of the responsibilities attached to a job under key categories – such as budgetary control, responsibility for assets, responsibility for people, work environment, technical skill, and occupational health and safety – and assessed each role against each of those categories. Jobs or roles that had greater responsibility for occupational health and safety received a higher rating for that category, in turn this was rewarded by a higher grading overall, and therefore a higher salary band.

One positive output of the Job Evaluation process was that those who had greater levels of responsibility for occupational health and safety were rewarded, and another was that as an outcome of this process, all employee job descriptions contained clear OHS responsibility. From 1996, all job advertisements - whether

internal to the business or advertised externally - contained the health and safety responsibilities attached with that role. In interviews for management and supervisory roles, part of the interview process focused specifically on occupational health and safety responsibility and management. The Human Resources team were given training and support from the Risk Manager in identifying appropriate questions and the desired responses.

Another vehicle for delivery of the safety message was the Health and Safety Induction. All employees - whether temporary or permanent - received a company and site induction when they started work with the business. The employee induction covered all aspects of work including holiday entitlements, company rules, disciplinary action, and occupational health and safety. After a site tour, the OHS induction, led by the Risk Department, covered all general aspects of health and safety including company policies, site rules, key risks, accident reporting system, and personal protective equipment. A more detailed discussion of local risks took place during the area induction with the Departmental Manager.

In 1996, to ensure that Occupational Health and Safety was regarded as having an equal footing with other key areas of management and integrated with 'the way things were done', the responsibility for the general health and safety induction was transferred to the Human Resources Department. The OHS induction then became part of the overall company/site induction process. The Risk Department provided the Human Resources team with appropriate training and induction notes. One of the objectives of transferring responsibility for OHS induction to the Human Resource Team, was to gain their direct involvement in Occupational Health and safety, from recruitment, to induction, to training and in the worst case, enforcement. Again, a more specific OHS induction was carried out by the Departmental Manager and focused on area specific risks, rules and procedures. The local manager also discussed specific and general risk assessments in that workplace, the hazard notification process and the communications forums used for occupational health and safety.

4.3.7 TEAM BRIEF AND OTHER COMMUNICATIONS FORUMS

4.3.7.1 The way it was

A vehicle of mass communication on each site was the monthly site team brief. Each Line Manager communicated the site brief to their team and this was in turn communicated to that employees team. At the start of the study, this brief was dominated by production needs, change management and pay and condition matters.

4.3.7.2 Change

The brief eventually contained a section on safety policies, and other site-wide issues such as designated smoking areas, enforcement of safety policies and studies or initiatives being carried out. The brief remained a top down communication, but it provided the opportunity for the central risk management function to communicate its policies as discussed at the safety committee meetings - with the authority of the Executive. There was also a section for employee Questions and Answers which were fed back for response. The Safety Representatives and/or Managers of each area brought the comments and issues raised at the brief to the next safety committee meeting. Perhaps 30% of the information disseminated was connected directly to OHS and much of the additional material was related in some way. This was a huge improvement.

In addition, there were newsletters, notice boards and TV screens all of which were used to communicate health and safety information and news. The awareness questionnaire had suggested that employees found these of limited value, and they were certainly not a preferred medium, but all routes were used. It was felt that the TV screens probably had the highest impact as they were placed in the canteen areas where people sat in rest periods, and therefore communicated to a captive audience. Whether the information had any benefit in terms of understanding and awareness other than increasing information available, is again uncertain.

Changes in Safety Rules and policies were communicated to managers and supervisors for communication at local briefs via the internal mail (e mail) system and the Management meeting. This ensured a consistent message was given to all

managers. Higher level safety issues and policies were discussed at the Senior Management meeting and the Management-Executive forum, to discuss and gain commitment to specific safety policies. The same communication processes and systems were used to communicate changes at all sites.

An additional forum for discussion of changes between sites was the Risk Control forum hosted by the Risk Control Manager, and attended by the Blythswood and Distilleries Safety Advisors, the Strathleven Safety co-ordinators and the company nurse. The meeting, held every two months, aimed to ensure that company policies were being implemented consistently, to discuss current issues and future strategy, and to share best practice between operating centres. Eventually, the Risk forum included other risk management issues on the agenda such as environmental management, risk finance and security.

The structure between the sites was such that the Central risk department provided the strategic leadership and standards - determined after consultation – then each different operating centre developed their own methods of achieving these standards, with assistance from the other sites. It was recognised that site Safety Advisors, and their respective sites, would have greater ownership if they developed their own systems.

4.3.8 ENFORCEMENT

There was a significantly higher rate of compliance with Safety Rules at Blythswood relative to compliance at Strathleven. The difference between these two sites was that, at the Blythswood site, there was strict enforcement of Safety Rules including taking disciplinary action where required. During the study period, disciplinary action was taken against a number of individuals at Blythswood for failing to adhere to safety policies. This may not exactly be participation, but it is a modification of safety behaviour of individuals, irrespective of their 'attitude' given that they have the knowledge and awareness not to behave like in a certain manner.

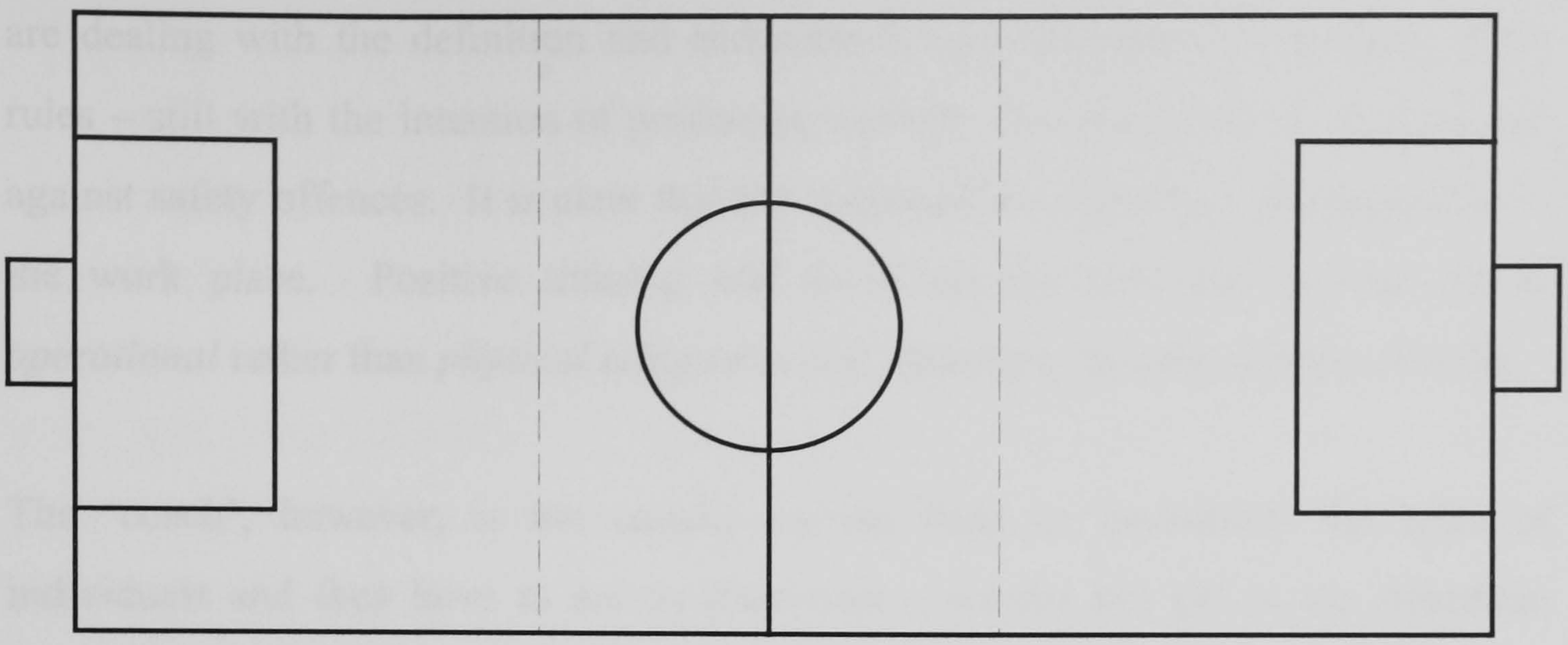
As a contrast, at Strathleven, Safety Rules were rarely enforced. The extent of

enforcement varied from Department to Department, but often Managers avoided taking disciplinary action for fear that this action would be overturned on appeal. Their fear was based on genuine (bitter) experience of general disciplinary matters – with strong Unions and a relatively weak Human Resources team - and therefore few Managers believed that they had the power of enforcement on their side. This led to a working environment where safety infringements were often 'overlooked' rather than actioned and resolved. Although enforcement should be viewed as a last resort, the absence of enforcement can lead to an even more negative safety environment.

4.3.9 SUMMARY – PEOPLE AND PARTICIPATION AND THE FOOTBALL ANALOGY

Accidents cannot be prevented by focus on human factors such as attitudes alone. Concentration on 'hard' control measures will significantly reduce the number of accidents that occur. Although the Norwegians, for example, use an analogy of barriers that is quite successful, an analogy that has proved useful in J&B is that of the football team and dimensions of the pitch.

On the right hand end of the pitch lie the proactive measures (human interventions) that, in principle, prevent errors being made in the first instance. This is the selection of a squad of players with sufficient skills and blend of skills to form a good team. In safety terms, these include knowledge and awareness of safe working and training to provide competence. In an ideal world, a positive impact on awareness would affect behaviour, but analysis of accident proneness suggests that unsafe behaviour and therefore accidents will still happen even when there is correct knowledge and awareness – even the best squad can field a losing team. These *human* aspects should, therefore, be treated as nice to have, but not as the sole means of preventing accidents – some teams cannot afford a squad with all the necessary playing qualities. Another team might have a player of great skill, but with unfortunate characteristics. This study recognises that even the best, positive attitude to safety will still not lead to zero accidents.



Last Line of Defence 'The Keeper'	Operational Safeguard 'Defence'	Supervision 'The Coach' 'Midfield'	Human Factors/ Skills 'Strikers' 'Team Selection'
Must be fail safe	Normally in use throughout the game both as a 'defence' and for building an 'attack' - production	Training Supervision Group Norms Management Communication Enforcement Discipline Written Safe Systems (the Rules) Control of the midfield gives control of the game.	Recruitment Competence Skills & skill provision Individual character Awareness Perception Understanding Team skills
Last defence only once mistake made – a *contingent* measure of safety	The correct/ safe operation by each individual and as a team.	The emphasis is on winning/scoring, but the midfield funnels back into defence when required	Selecting the correct person for the role

The point of interface between man and machine in an industrial setting – the task level - is analogous to supervision or coaching in a football squad. In the 'midfield', effective coaching and enforcement of tactics can prevent unsafe behaviour and, on the other hand, a poor or inexperienced or tactically unaware coach can promote or overlook unsafe behaviour. The output of effective coaching is competent play to provide a basis for winning the game – by setting up positions to score and by denying the opposition the opportunity to get close enough to score. In industry we

are dealing with the definition and enforcement of safe behaviour through safety rules – still with the intention of producing a profit - and taking disciplinary action against safety offences. It is clear that the 'midfield' is critical to safe behaviour in the work place. Positive training will focus on the safe and correct use of *operational* rather than *physical* safeguards and, therefore, on safe systems of work.

The 'coach', however, is not usually on the field to 'man-mark' the team of individuals and they have to act on their own – we are not yet in the American football situation of control by radio. In industry, the workforce must also be free to work – and make mistakes – as constant supervision or even monitoring is practically and financially impossible. The first control system that is in place, therefore, is made up of operational safeguards that set limits on an operator whilst performing a task, such as an emergency stop button to be used before entry to a machine, or a lock-off device. Prior thought – *risk analysis* – defines these systems. In football, the defence (and midfield) are constantly positioning themselves to counter any moves forward by the opposition – whether stemming from a mistake by their own attack or a spark of brilliance by the normally *plodding* but persistent opposition.

These systems rely on the operator understanding the purpose of the *defence* systems and knowing when and how to use operational safeguards. Further, (s)he must actually use the safeguard, (which relates to the individuals personal characteristics), when circumstances require. If the operator is put under pressure, (s)he may forget. Given these factors, the operational safeguard must work when required to do so, and thus be carefully maintained. In the midfield and defence tactical awareness is critical. Everything relies on thinking ahead and on being able to put knowledge into action.

In certain circumstances, where there has been human error or a violation of procedures on the part of the operator, he or she manages to bypass the operational safeguard or 'defence' - a defender may miss a tackle, may lose concentration or may make a miserable pass-back to the keeper. The final line of defence or the 'keeper'

between the operator and an injury may be a fixed distance guard, an interlock guard, trip switch or other fail safe device. Clearly, these must work and have an extremely high level of reliability. They separate the operator from the danger zone itself and are *contingent* on a mistake having been made.

It has been noted elsewhere that focusing upon awareness alone is not sufficient to prevent accidents. To prevent injury accidents, focus should first be on elimination of a hazard (removing the goal mouth by playing the game in the opponents half!). Assuming that this is not possible – and it never is - focus should be on the 'defence' and building a 'defensive midfield'.

There should be operational safeguards in place that define normal operation - the correct way to carry out a task. This safe system of work will have been communicated during training and the supervisor (coach) will try to ensure that the task is performed in this manner. As a means of mechanical intervention, in event of human error, there must be a last line of defence between the operator and the hazard that must be fail-safe, well maintained and impossible to bypass.

On the positive side, further attempts can be made to educate, raise awareness and raise competence, although these cannot be relied upon to prevent accidents or unsafe behaviour. There may be clear limits on the ability to influence these factors. In principle, in a highly competent work team, the defence is pulled further forward on the pitch - where knowledge, understanding and competence prevent incorrect actions and the last line of defence is only in place to protect against pure 'accidents', rather than to protect against errors.

With all these measures, the interface between the mechanical factors and human factors is the most important focus for training and enforcement of correct behaviour. The 'keeper' or guard only has effect when a mistake has already been made, and clearly it is better to have influence upon an individual who has yet to make an error. Training should focus upon the correct use of operational safeguards and the interface between man and machine, and the use of safe systems of work.

Human factors such as knowledge, supervision or attitude cannot be relied upon to prevent accidental injury or loss. Another important aspect of training is to ensure that people understand the link between unsafe acts/behaviour and accidents. Procedures should be implemented to eliminate the risk at all, to reduce and control the risk by operational safeguards.

Excluding the impact of *pure* human error, if all employees in a workplace could be guaranteed to act safely, the final line of defence would not be required. However, error is a very real issue and most accidents are caused by a combination of initiators and circumstances. The extent and type of physical control measures required are dependant upon the level of 'risk' (potential severity and probability). In some cases, the last line of defence may be personal protective equipment such as gloves or a mask.

In summary, this study suggests that to increase safety standards and reduce accidents, a company should focus first and foremost on physical control systems, effective supervision and practical training on safe systems of work. If there is a knock-on effect of a positive change in expressed attitude, then this should be treated as an added bonus rather than as a desired outcome. Participation by employees within the business, at all stages of this process is key to continuous improvement of safety standards.

5 DISCUSSION AND CONCLUSION

5.1 INTRODUCTION

Many things were considered for J&B Scotland and many things were tried. It was clear from the start that some things were essential – *sine qua non*. Thus, a formalisation of policy and the writing of procedures that reflected real working life had to be part of the scheme of work.

The goal was to involve the workforce in safety. This meant that they had to changed in some way, but was this possible? No. All that could be done was to set up structures that steered the workforce to involvement through safety committees, risk assessment, and training. Management needed to be trained, scared into accepting their role, encouraged, bribed and even coerced. Senior management in theory, need to be competent, committed and to provide resources (Dawson, 1988). However, one cannot rely upon senior management commitment as Executive Teams change by the year and therefore, perhaps at an even faster pace, the management team changes.

What can be done ? The inertia of the plant workforce helped – the lack of change in the overall team, reduced the impact of the 'coach' or 'midfield'. How then can success be measured – we need to get some feed back so we know if we are doing the right thing. We don't learn what to do from the output of accidents. What can we use?

Not every initiative taken succeeded, and not every proposal proved practical to implement. In fact, some ideas were tried (costs of accidents) and yet will not be used again. The management of OHS within J&B was however, moved on. Processes were defined, standardised across the company and moved towards proactive management, measurement and control.

The objective of the study was to develop a formal, structured and measurable safety management system appropriate for the company. This system had to be suitable and

effective for all sites and operations and to be developed with the objective of future integration with ISO. The system had to be consistent and appropriate for effective integration. Alongside the management system, a comprehensive system of performance measurement, incorporating both positive and negative measures was to be developed, to provide a system for ensuring continuous improvement. Again, the system had to be practical and workable within the operating environment, although not all measures would necessarily be performed locally. The study also set out to consider the roles of the individuals within a working environment in relation to safety and pursue the active involvement and participation of employees in safety management. Each aspect of this study will be discussed in turn.

5.2 SAFETY MANAGEMENT SYSTEM

At the outset, a status review was conducted to establish a benchmark position for the company – in terms of management, organisation, systems and standards in place, safety awareness, accident and audit results, and most importantly physical evidence from the seven sites.

In summary, it was determined that there were no formal safety management systems in place, and therefore vast inconsistencies in standards, management styles and policies existed between sites and Departments. Another key finding was that the only performance measure being used was negative (accident data), and this information was collected and analysed inconsistently. Finally, it was clear that the management of safety was seen to be the sole responsibility of the Health and Safety Manager.

At the same time, to some extent because of the organisational position, an attempt was made to examine whether there were clear links and synergies between quality management and safety management. Important synergies were identified, but there were also significant differences in that there are legal requirements for safety, quality management focuses on products not people and there are inherent difficulties in capturing information on safety errors that do not exist for quality errors. A systems based approach, however, is of equal benefit to safety

management and quality management to ensure consistency of approach and is the baseline of good management practice. This study then set out to develop a safety management system similar to the ISO *product quality* system already in existence within J&B.

A safety management system was developed and later compared with the Guidance Standard BS 8800. The first consultative document for the British Standard was issued during the research process, and proposed that either the ISO 14,000 Environmental management standard or HS (G) 65 be used as a model for a safety management system. As this study was already using the Quality Management standard ISO 9002 for guidance, there was a good match in approaches.

The development of the safety management system required the development of a new safety policy, safety procedures, safe systems of work with related documentation and a review process. The task was an onerous one as there was precious little in place to work from, and the system had to be appropriate and of benefit to all seven operating sites – reflecting cultural differences but ensuring consistency of standards and approach. It was important that the safety policies were all the same, but the work instructions and local procedures could and did differ, albeit they set out to achieve the same standards. The key to the effective development of this system was establishing cross-site working parties that had input to and ownership of the overall system from the outset. Communication of the new safety policy and safety management system overall was critical – the cross site working party communicated the messages together at each site, with executive backing and presence at each forum. Groups of key individuals were involved during the development phase – safety co-ordinators, safety reps, Line Managers, Executive team- to help gain *buy-in* after the first phase (Policy and Procedures) was launched.

The involvement of these individuals was important as during the second phase of system development, almost all of them were involved in writing and drafting work instructions and safe systems of work for their work area. It is, perhaps of interest

that a proposal to extend the framework system to other IDV units was under discussion at the end of the project.

Overall, the main benefit of the safety management system was that it formalised and standardised safety management standards and policies across sites. Involvement of the production staff in development of the system and safety standards increased the level of knowledge and awareness of policies, legislation, standards and procedures of all of those involved. This was definitely a positive outcome.

5.3 SAFETY PERFORMANCE MEASUREMENT

The second phase of the study was the development of a comprehensive system of safety performance measurement - to allow a performance review as a follow on to the initial status review, and to enable continuous improvement. A number of different tools were evaluated. It was recognised that the tools used for other business processes were not generally suitable for safety management, and that the tools selected must be both appropriate to safety management and to the culture, risks, management structure, expertise and resources of J&B. There are some techniques available that are just not commercially suitable because of the resources required. Cost-efficiency is important in Safety Management as well! It was also recognised that the measurement system should record both negative and positive measures – for example, accidents and targets achieved.

The three main techniques used in industry – monitoring, auditing and intensive studies were all considered. Monitoring of accident statistics is the most commonly used, and abused, tool for the measurement of safety performance. It can be a dangerous measure as it is used by almost all businesses, whether large or small, and understood by very few. It was found at J&B – and it is almost certainly true of other drinks companies – that all manner of matters *confounded* the statistics so that the effects of individual factors could not be distinguished. The most important of these confounding effects were the regular change in management organisation, the constantly changing business targets imposed by the group and the consequent changes in systems of work and staff levels. Initiative overload!

A case study on Monitoring was performed, and it was found to be extremely difficult to capture consistent accident data from Department to Department, and site to site. As there are relatively few accidents within J&B Scotland, in order to have any statistical significance *accurate consistent* data had to be analysed over a 5-year period. Often accurate, consistently collected data could not be derived (just did not exist and could not be made to exist) for all sites over such a timescale, and there is no value in comparing inconsistent data for trends. Even with such information it would take several years to establish if there had been a significant change in performance – not useful when trying to see if safety campaigns or training are working. Probably the biggest difficulty was the amount of statistical knowledge that a practitioner would require to draw useful conclusions for the data.

There is no doubt that event recording remains the most common measure of safety performance, but the strongest use is to pinpoint trends in types and locations of incidents. That is in a comparative rather than an absolute sense and it is investigation rather than counting of events that is important.

Linked to this was a study of the Cost of Accidents. There was expected to be a huge financial loss as a result of accidents each year. An intensive study over a 12 month period costed every recorded incident in detail. The process, although simplified to save manhours and the cost of resource, was still time consuming. There were a number of positive outcomes, but not the expected ones! First, it was discovered that the total cost of accidents in a 12 month period was £141,422, trivial in terms of turnover, much less than had been expected and unlikely to have much impact on the Executive Team in any competition for resources! On the other hand, a great deal of information was uncovered on the risk finance alternatives, including the redistribution of insured cost to sites and units in line with the level of risk.

There was also evidence of failure to report incidents within the business. A shortened costing method was developed for specific case studies, and to form part of cost benefit case studies. It was concluded that the shortened costing exercises have their place for specific incidents, but that a full Costing exercise will not

generally be of significant benefit to an established business where safety systems are already in place.

Auditing, the second main technique, was examined in detail. This technique is both positive as well as negative in concept in that it captures what has been done instead of measuring only system failures. A number of proprietary systems were examined, and an audit system that was suitable in terms of time, cost and resource was selected. The system was built around individual interviews of a number of key players at all levels of the business, a documentation check and physical verification of safe systems and work practices on site. The technique of auditing was very useful for J&B - it provided a focus on health and safety that had not been there before, and it acted as a catalyst for change. The safety audits required a number of people to be involved, both in audit preparation and during the audit process itself, and it provided an opportunity to link safety performance to performance linked pay. A very important conclusion, however, is that all systems have a useful lifetime and the audit system should be changed or modified before this is reached. On the other hand, it is important that this system is not changed *too* often or there will be nothing to benchmark against.

Intensive studies were carried out in the forms of questionnaire and interview surveys of attitude and awareness. It is a conclusion of this work, discussed below, that expressed attitudes do not determine behaviour and so there is no merit in capturing safety attitudes. It is of more benefit to capture safety awareness and the extent of knowledge. Safety 'culture' therefore is something that a company will recognise that is *has*, or has not, rather than a measurable quality.

In essence, the questionnaire study was useful in that it captured the extent of knowledge of a specific safety issue from a number of employees. Thus, this is a useful technique for specific issues only, perhaps repeated over a set period of time, or to check if training has had an impact on knowledge. The second technique – an interview study - was extremely time consuming but revealed useful insights to safety management within J&B. This is judged to be a useful technique if carried

out by specialists on perhaps a 3-5 yearly basis. As a benchmarking exercise it has value, but it is not a true measure of health and safety performance.

Another form of intensive study – observation of behaviour - was not implemented within J&B due to the resources and skills required. It is seen to be a useful technique for specific tasks or issues, but not as an ongoing tool separate from task risk assessment. For example, if an accident happens without obvious cause then intensive study of the system of work may indicate flaws.

5.4 PEOPLE AND PARTICIPATION

There has been a great deal of discussion surrounding the role of safety attitudes and behaviour on safety performance. Conventional safety performance measures focus on visible effects of safety in the workplace – safety behaviour. Another school of thought believes that if you can change the safety culture (and mindset), you can change accident experience. Both sides of this debate have been discussed and because there is doubt that expressed intention to act is always causally linked with behaviour, it is certainly more accurate to focus on safety knowledge, understanding and awareness rather than on the measurement of an attitude itself.

It is also the case that in the workplace, there are a number of external influences upon an individual – in particular the effect of the group norm. It is not correct to focus on the individual in the workplace, as the interactions with the group have a large influence on behaviour. This study, therefore, concludes that whilst it is *nice* to measure attitudes, to have an impact on safety in the workplace, one must influence the group norm. This is in disagreement with, for example, Glendon and McKenna (1995) who see utility in attitude studies.

It is interesting that within this context, some individuals still have more accidents and incidents than others. There are accident prone people in the world! Experience in J&B suggest these people are typified by 'do or say before think' but the facts certainly go against those who would deny that accident proneness exists.

5.5 SUCCESSES

The comprehensive system for the management of safety in J&B Scotland has achieved several *wins*.

The profile of safety management was raised almost beyond recognition within the company; and was eventually integral to the way that the company managed its business. With the safety management system in place, there is a system of control upon which the company can progress. Control can be tightened and standards can be improved. In other words, the system is now *in* control.

The study demonstrates what can be done, and what cannot. For example, questionnaires do not work, but enforcement does (in the short term at least).

An interesting by product of the study is that by changing hard systems, some soft factors have also changed. The study was intended to impact upon the core safety management systems and control measures. However, a side benefit is that over the period of study some people have perhaps changed their attitude and certainly changed their behaviour as a result of visible changes in work systems.

The study provided a baseline so that any improvement or decline could have been measured. In the future there would have been a basis for understanding where we had moved from, and future changes would also have been visible. Obviously this assumption is based on the belief that the audit measurements really do measure a standard of safety management that relates to accidental loss. The improved results in the annual CHASE audit from 40% in 1993 to 77% in 1997 show a definite improvement in demonstration, but has it actually shown an improvement in safety standards ? The raw accident statistics would say not, evaluation of the audit process, however, in conjunction with other safety measurables leads to a conclusion that there was a real improvement on safety standards.

Another success was the achievement of a ROSPA Gold Award. However, there is doubt and cynicism as to what this actually means. After all, the accident statistics

are self-reported and as we are very aware, there is not a uniform standard of accident reporting. The main benefit is that is acted as an internal motivator related to Safety Committee team building, but it does not actually improve safety standards or provide a commitment that was not already there.

So, what has actually been achieved ? The answer is a solid base for further improvement that is measurable and enforceable.

5.6 LIMITATIONS, FAILURES AND CONSTRAINTS TO STUDY

The main constraint to the study was that production came first. As Brehmer (1993) noted, Prospect Theory applies to apportionment of resources. The amount of money available to spend on the improvement of safety standards is limited and also secondary to the requirements of production. As discussed previously there is a limited return from safety, and the return is in terms of reduced loss rather than increased profit.

Within the company there has been an almost constant changes of personnel and operating structure. There have been many changes in Operations in 4 years : there were 3 Operational Directors, 2 Managing Directors, 2 Human Resources Directors, 2 changes in Risk Managers/ Safety Managers, 3 Production Managers and a variety of other key personnel changes. On the other hand, at the lowest level there have been less than 5% changes in operational staff. These changes in personnel have meant that no sooner has an individual been trained or developed an understanding and commitment to safety management, then their position has changed and another individual has to be trained. There has been a problem then in consistency, which in part has been countered by the development of consistent, documented safety management systems. It is clear, however, that improvements in safety can also be achieved by the involvement of the actual operators themselves, who do not change as frequently.

Time was also an issue, the period of the study was around 3½- 4 years, and many changes in standards of safety management are rather more long term than that. In

addition, many of the projects were medium to long term, and these were initiated in a constantly changing environment. This required goal posts to be changed. It was frustrating that, just when one group of key players had just been convinced, there was an 'all change' situation, so the task of convincing and motivating had to start all over again. To use the football analogy again, you constantly checked that the size of the pitch was the same, and that the goal posts were the same size, but then you found that the team itself had changed and the rules and strategy have to be explained all over again. Often it seemed like the coaches and players spoke different languages.

5.7 WHAT TO DO

5.7.1 Where to start

This study has identified a number of key issues that are critical to the success of a safety program. It is recommended that these issues are addressed at the outset of a new safety management program - for example, in the event of a change of safety personnel.

One of the first issues to address is the embedding of the safety function within the organisational structure. It is recommended that the Safety function falls within the same sphere of responsibility as Quality Assurance, and that safety management systems are unified with those of Quality Assurance. It is essential that an effective organisational structure is in place to manage safety within the business. An evaluation of resources should be conducted to ensure that they are appropriate for the business requirements. This review should include the role and competence of safety representatives to ensure that they are providing an effective resource with which to improve the safety program. To ensure that there is appropriate commitment and visibility at Senior Management level a Senior Management (safety) Review Group should be put together – meeting bi-monthly or quarterly – to agree policy and objectives and measure performance. This is critical to program success.

At the outset a comprehensive gap analysis (or safety audit) should be carried out to identify where the business is failing to meet legislative or corporate standards. This analysis will provide a baseline from which to prioritise actions and measure

performance. It may also find that corporate standards are deficient or non existent!

A comprehensive safety management system should be developed – and it must specifically address those items identified as non-conformances during the gap analysis. Employee involvement in procedural development, training, and communication is vital to effectiveness – there is no value in safety procedures being issued and remaining on Manager's shelves.

A campaign must be initiated to ensure that all accidents and incidents are reported, and can therefore be addressed. For this reason, it is essential that employees are not awarded bonuses (or punished except in extreme cases) in relation to accident performance. All accidents and incidents must be thoroughly investigated to identify root causes and to ensure that appropriate preventative actions are taken. A simplified Cost of Accidents study should be implemented to evaluate the key cost factors for the business. If the costs highlighted by the simplified study are significant or otherwise interesting, then a more detailed study should be conducted. The Employer's Liability insurance program should be evaluated to identify opportunities for cost-savings or rewards for improved performance.

The first steps should be taken to involve the Safety Representatives by prioritising their training and by raising the profile of the management input to the meetings

5.7.2 Continuing on

As the safety program progresses, a number of other techniques should be considered. It is critical that the physical deficiencies are identified and eliminated from the workplace – this can be assessed through monitoring the root causes of accidents and through general risk assessment findings. Specific risk assessment techniques such as HAZOP and HAZAN should be considered for high risk activities, where necessary. The program should aim first to eliminate all accidents caused by physical deficiencies and management system failures, and then address those caused by unsafe or faulty behaviour. Only at this stage of Process Maturity can a behavioural program have a true impact.

A business specific audit program should be developed. This is a powerful tool to measure and drive change over time, but as the audit tool outlives its usefulness it must be re-focused. It is essential that the action plans identified by the audit program are managed to closure by the Senior Management team. For the safety management system to work, Managers must be held accountable for all aspects of safety management, as they are with all other aspects of business management such as budget control or achievement of production targets.

Key Performance Indicators must be implemented and tracked, although the emphasis must not be on accident performance, rather it must focus on positive measures such as: actions closed out, reduced severity of accidents, reduced number of lost days, audit scores, number of inspections conducted, number of non-conformances identified, training carried out. The numbers of accidents or incidents must still be recorded and this must be complemented by the equivalent production and manhour records. A holistic performance measurement systems should be implemented that incorporates both hard and soft performance measures.

Accident investigations, safety committee meetings, results of surveys and risk assessments will provide useful information on key issues in the workplace. Specific campaigns should be launched to address key issues and target and improve specific behaviours, for example safe fork lift driving, or use of safety footwear. It is essential that the safety representatives have a key role in these campaigns - perhaps even leading them - rather than them being Management-led initiatives. The business should focus on provision of effective, useful safety communication and training. The safety committees should be used as a tool to ensure that all safety information is effective and useful to its audience.

To ensure the continuing success of a safety program it is essential that safety is built into the functions and written into the job descriptions of all employees, and all employees must be given objectives in relation to safety improvements. This process of defining the safe ways of working is the most powerful way of bringing the

workforce into line with the needs for safe working. Safety must be an integral part of 'the way things are done around here'.

5.8 FURTHER RESEARCH

The study answered some questions but it raised even more. There were several key areas in which the student would like to see further progress.

First, could the comprehensive safety management system transfer across the different operating units of IDV, outwith the United Kingdom? And would the system transfer to other companies within the UK, but outwith IDV?

Second, does the implementation of a safety management system actually have an effect on hard measures (such as accident data) in the medium to long term outwith the study period?

Thirdly, and more importantly, does a controlled system for the management of safety actually reduce the number of accidents or increase the standard of health and safety, *at all*?

The answers to these questions, just as the search for a Holy Grail may not be definitive, but they are certainly intriguing work for further research.

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APPENDIX FIGURES

RAW DATA AGAINST TIME

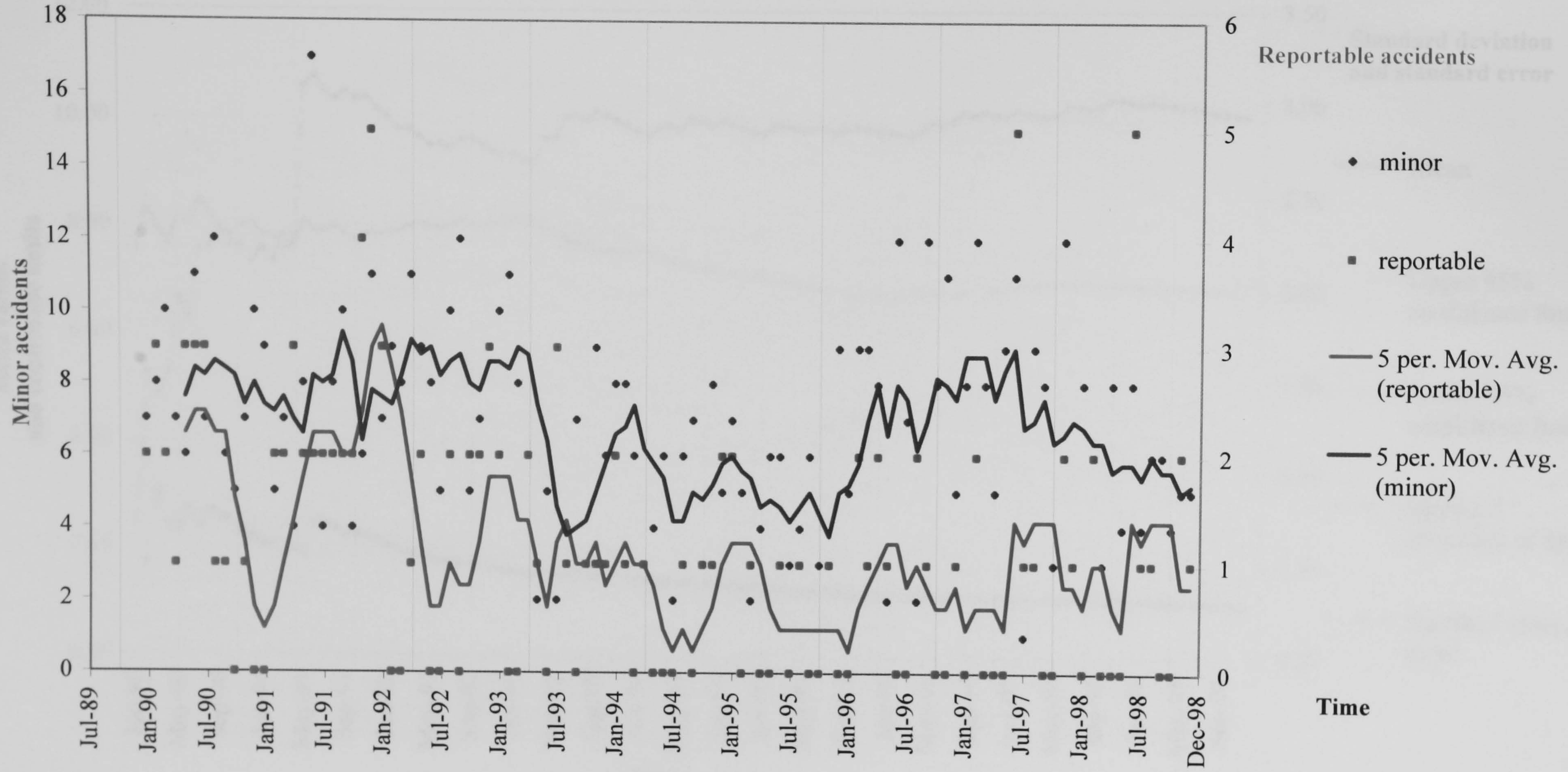

Figure 1

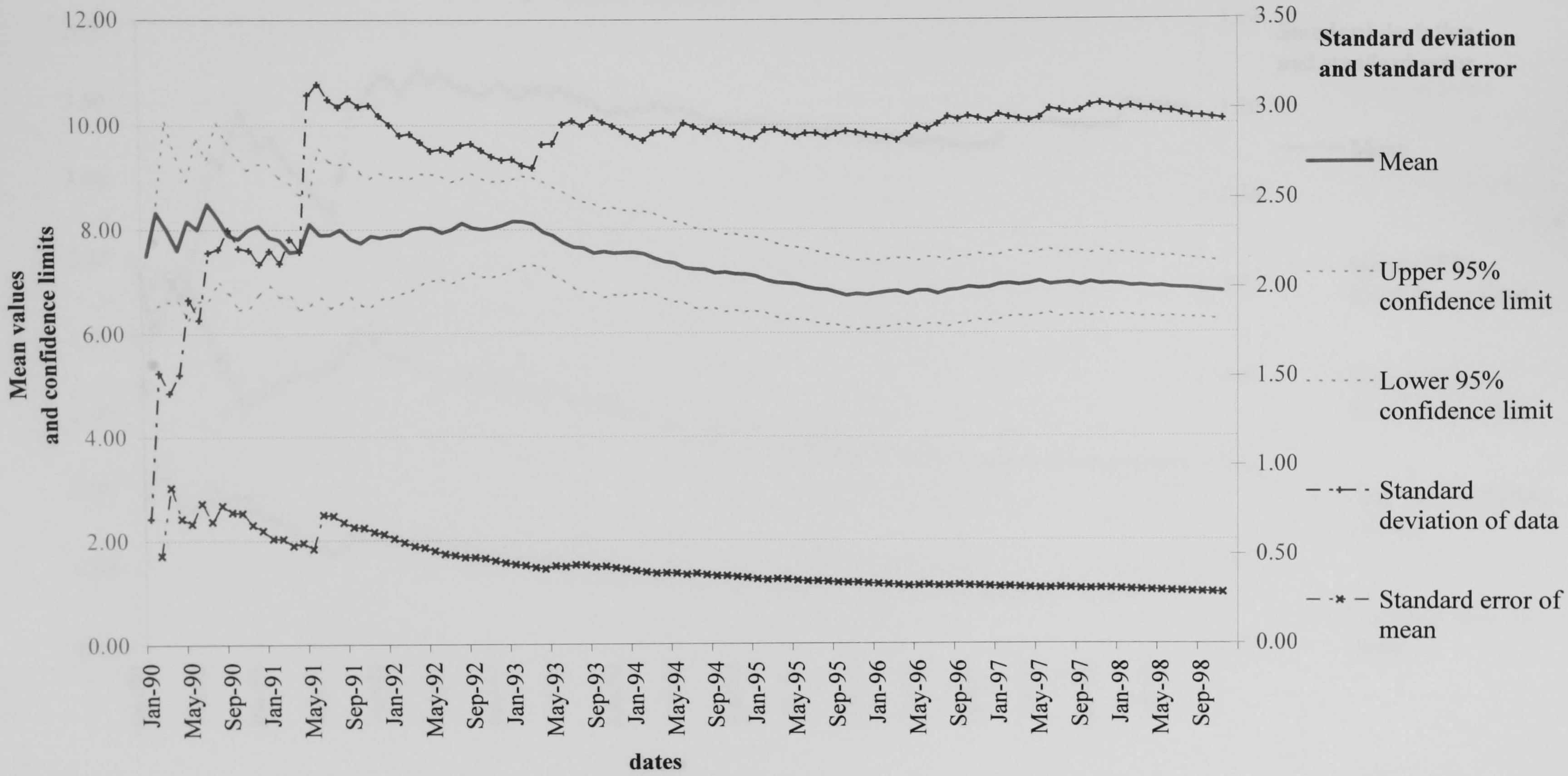
MINOR Accidents
development of mean and stdev over time
Mean values and confidence limits
Standard deviation and standard error
12.00
10.00
8.00
6.00
4.00
2.00
0.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Jan-90
May-90
Sep-90
Jan-91
May-91
Sep-91
Jan-92
May-92
Sep-92
Jan-93
May-93
Sep-93
Jan-94
May-94
Sep-94
Jan-95
May-95
Sep-95
Jan-96
May-96
Sep-96
Jan-97
May-97
Sep-97
Jan-98
May-98
Sep-98
dates
Mean
Upper 95% confidence limit
Lower 95% confidence limit
Standard deviation of data
Standard error of mean

Figure 2

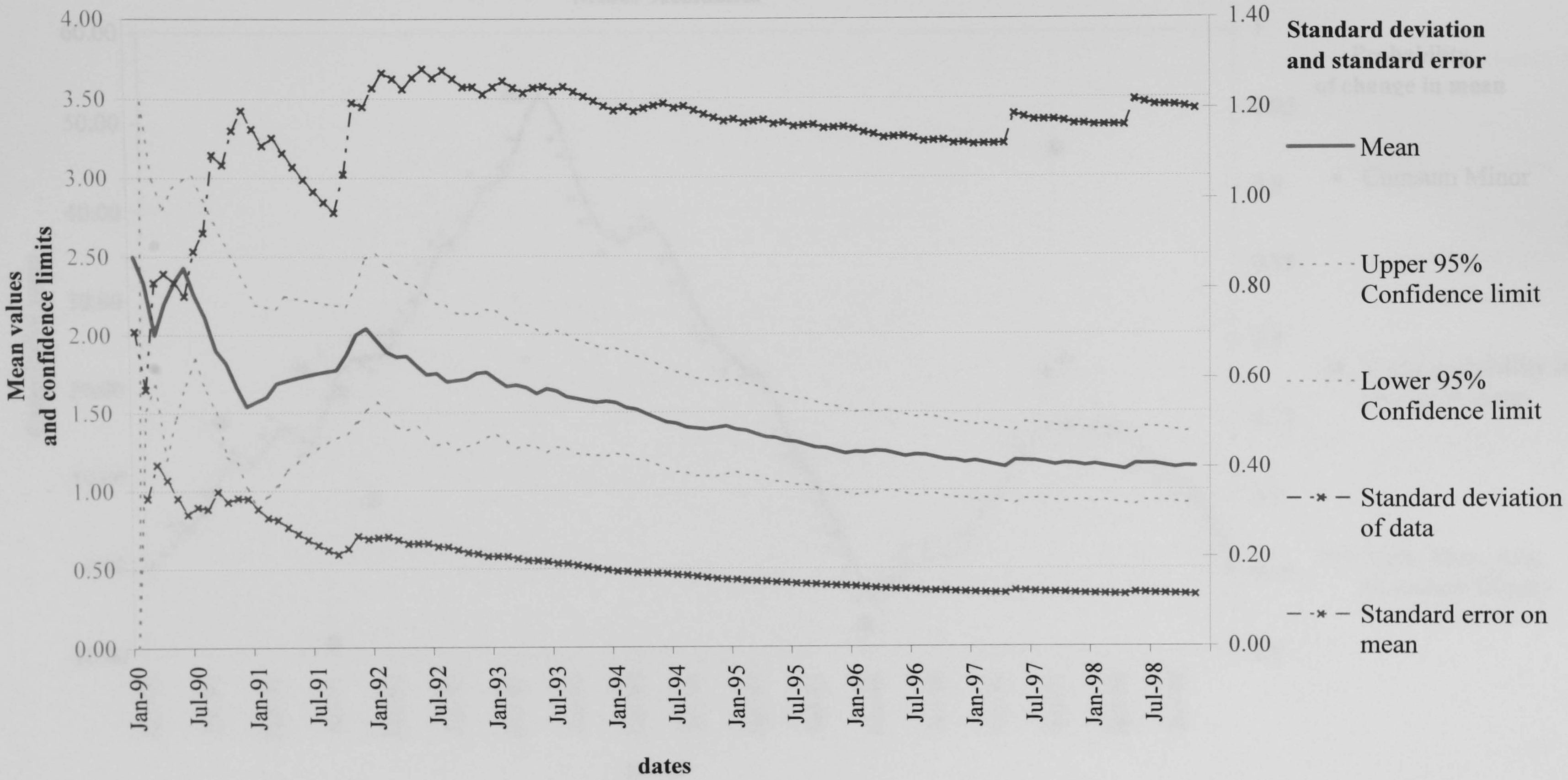
REPORTABLE Accidents
development of mean and stdev over time
Mean values and confidence limits
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Standard deviation and standard error
Jan-90
Jul-90
Jan-91
Jul-91
Jan-92
Jul-92
Jan-93
Jul-93
Jan-94
Jul-94
Jan-95
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
dates
Mean
Upper 95% Confidence limit
Lower 95% Confidence limit
Standard deviation of data
Standard error on mean

Figure 3

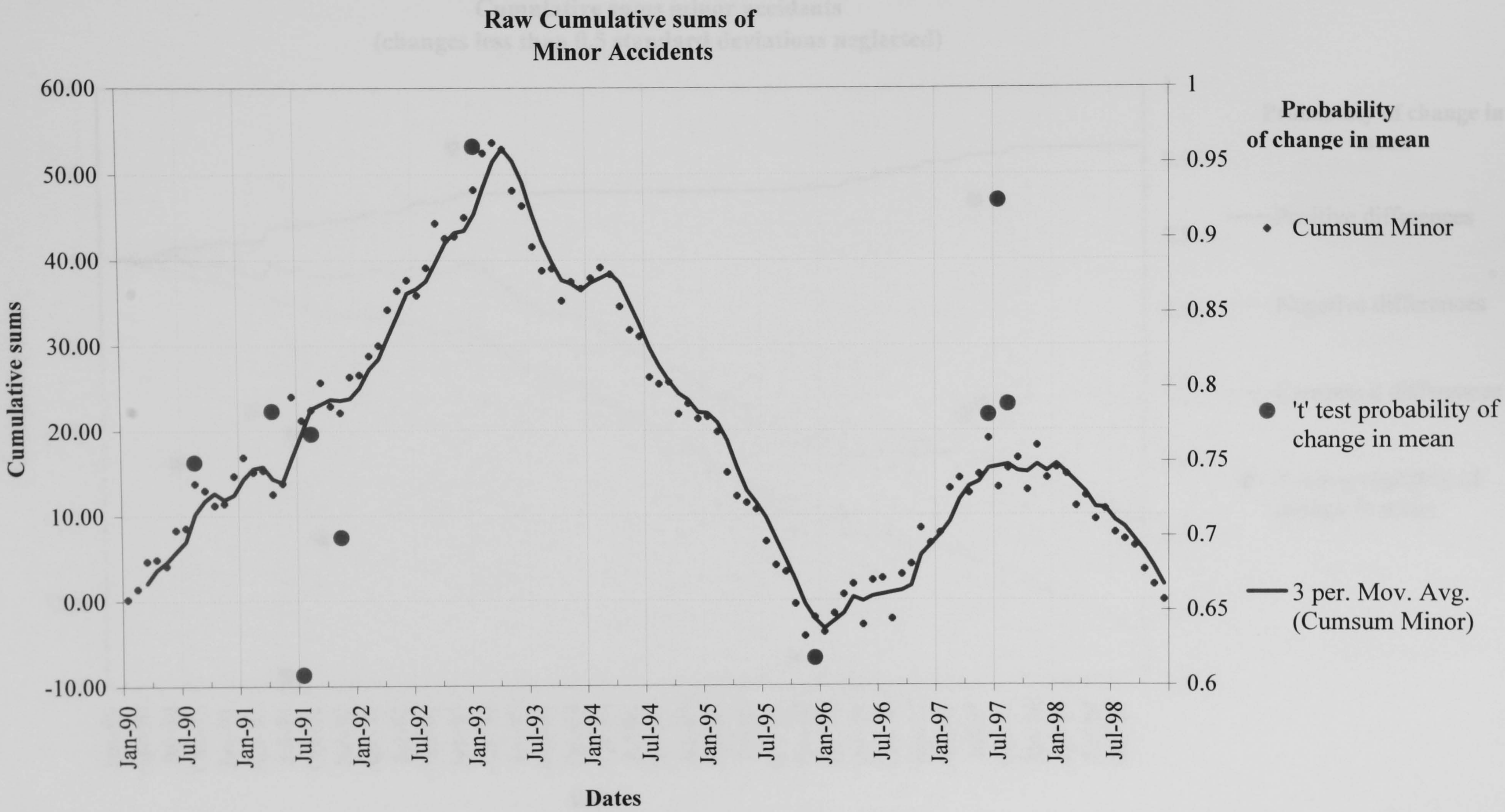
Raw Cumulative sums of
Minor Accidents
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-10.00
Cumulative sums
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Probability
of change in mean
Cumsum Minor
't' test probability of
change in mean
3 per. Mov. Avg.
(Cumsum Minor)
Jan-90
Jul-90
Jan-91
Jul-91
Jan-92
Jul-92
Jan-93
Jul-93
Jan-94
Jul-94
Jan-95
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Dates

Figure 4

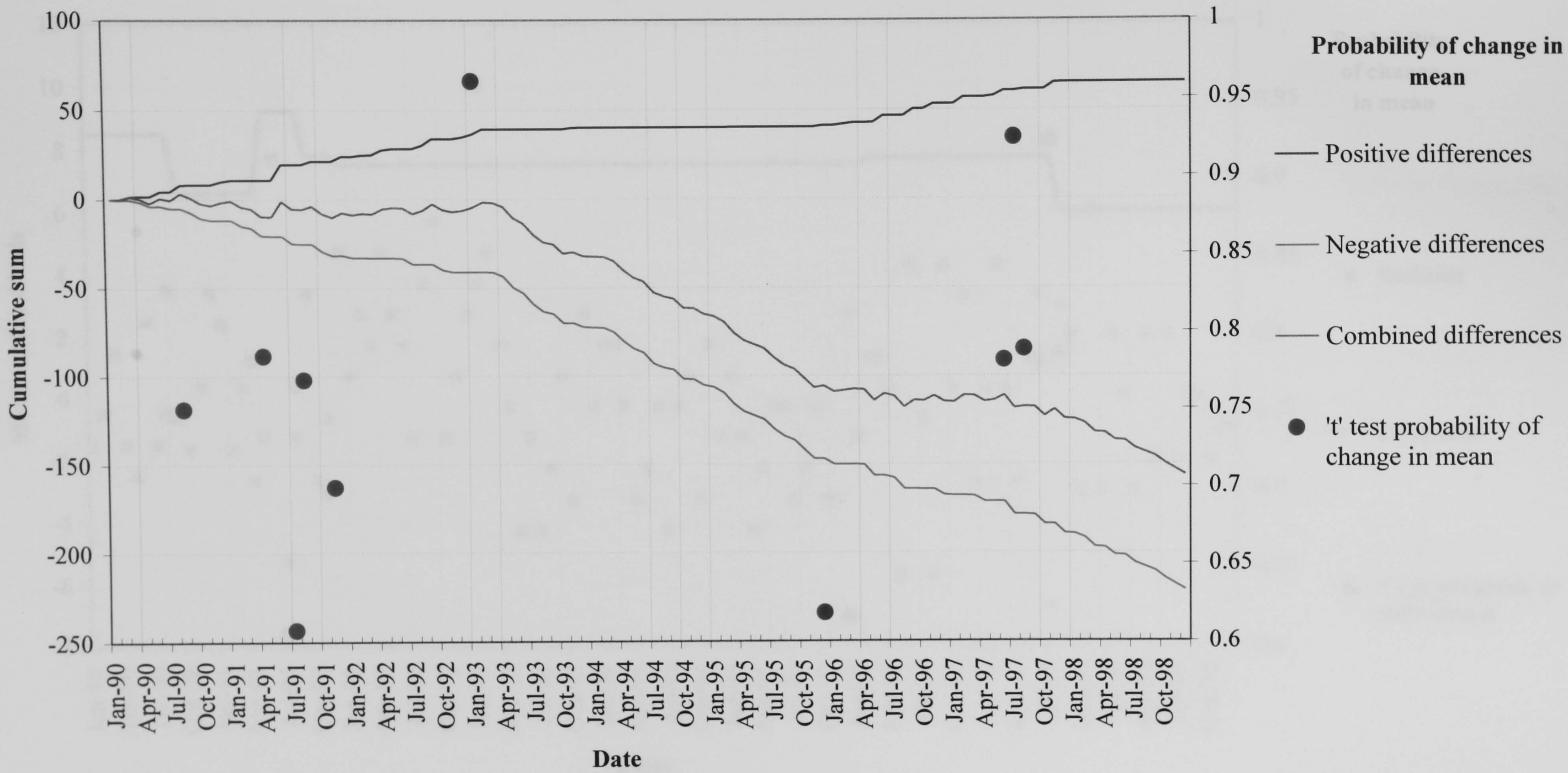
Cumulative sums minor accidents
(changes less than 0.5 standard deviations neglected)
Cumulative sum
100
50
0
-50
-100
-150
-200
-250
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Probability of change in mean
Positive differences
Negative differences
Combined differences
't' test probability of change in mean
Jan-90
Apr-90
Jul-90
Oct-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jan-93
Apr-93
Jul-93
Oct-93
Jan-94
Apr-94
Jul-94
Oct-94
Jan-95
Apr-95
Jul-95
Oct-95
Jan-96
Apr-96
Jul-96
Oct-96
Jan-97
Apr-97
Jul-97
Oct-97
Jan-98
Apr-98
Jul-98
Oct-98
Date

Figure 5

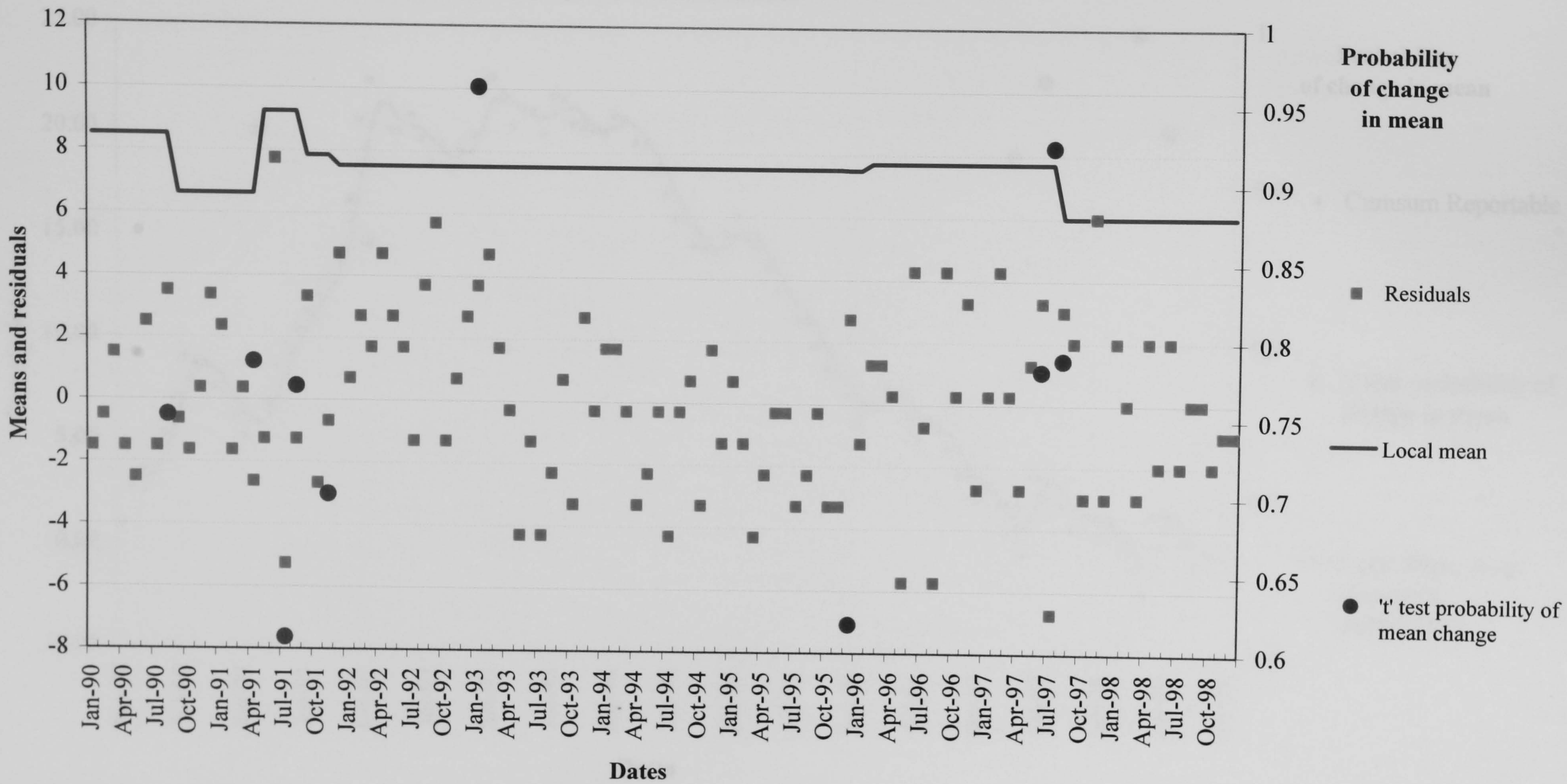
Minor accidents
Local means and residuals
Means and residuals
Probability of change in mean
Residuals
Local mean
't' test probability of mean change
Dates
12
10
8
6
4
2
0
-2
-4
-6
-8
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Jan-90
Apr-90
Jul-90
Oct-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jan-93
Apr-93
Jul-93
Oct-93
Jan-94
Apr-94
Jul-94
Oct-94
Jan-95
Apr-95
Jul-95
Oct-95
Jan-96
Apr-96
Jul-96
Oct-96
Jan-97
Apr-97
Jul-97
Oct-97
Jan-98
Apr-98
Jul-98
Oct-98

Figure 6

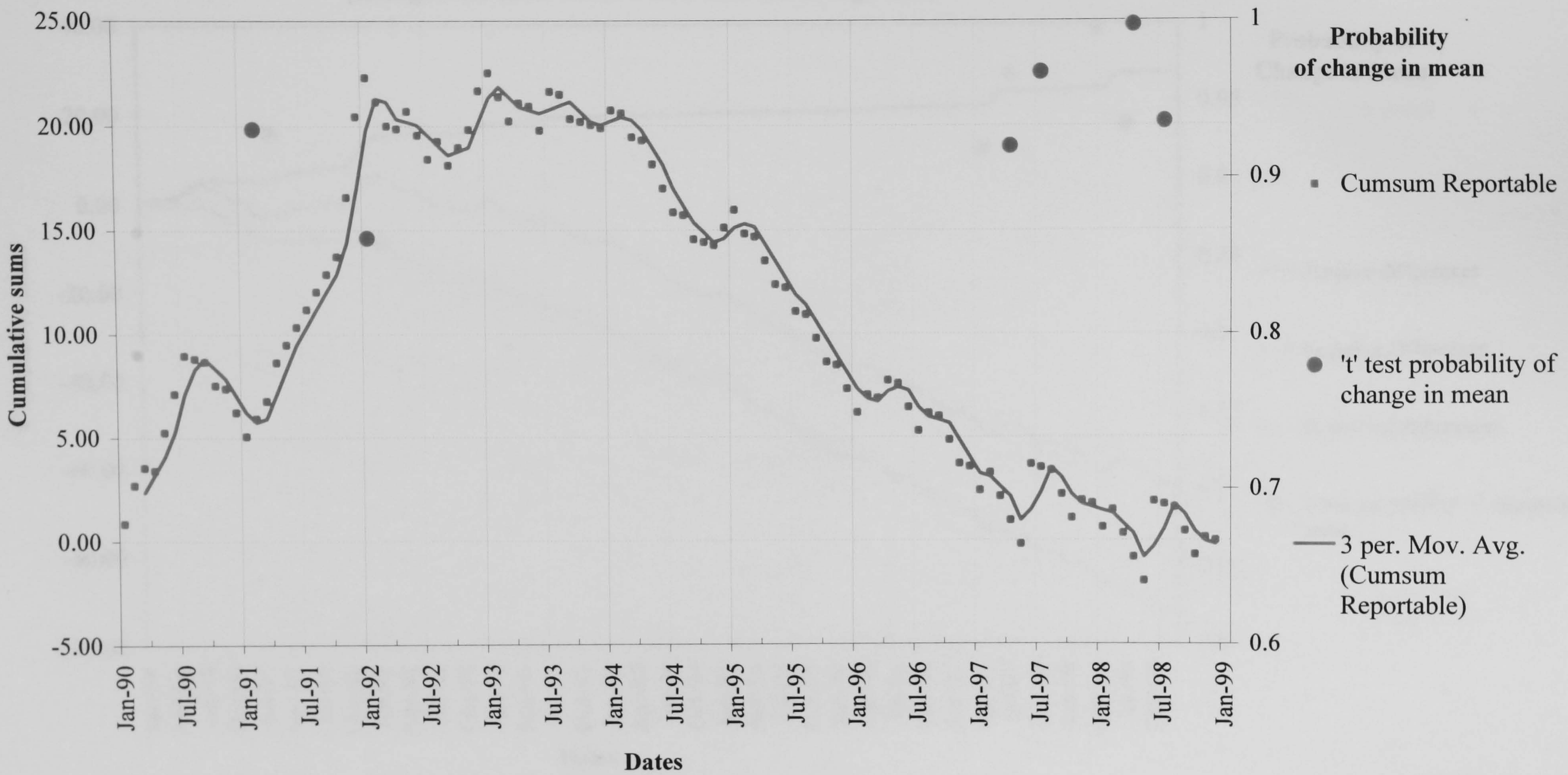
Raw Cumulative sums of Reportable accidents
Cumulative sums
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
Jan-90
Jul-90
Jan-91
Jul-91
Jan-92
Jul-92
Jan-93
Jul-93
Jan-94
Jul-94
Jan-95
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Dates
1
0.9
0.8
0.7
0.6
Probability of change in mean
Cumsum Reportable
't' test probability of change in mean
3 per. Mov. Avg. (Cumsum Reportable)

Figure 7

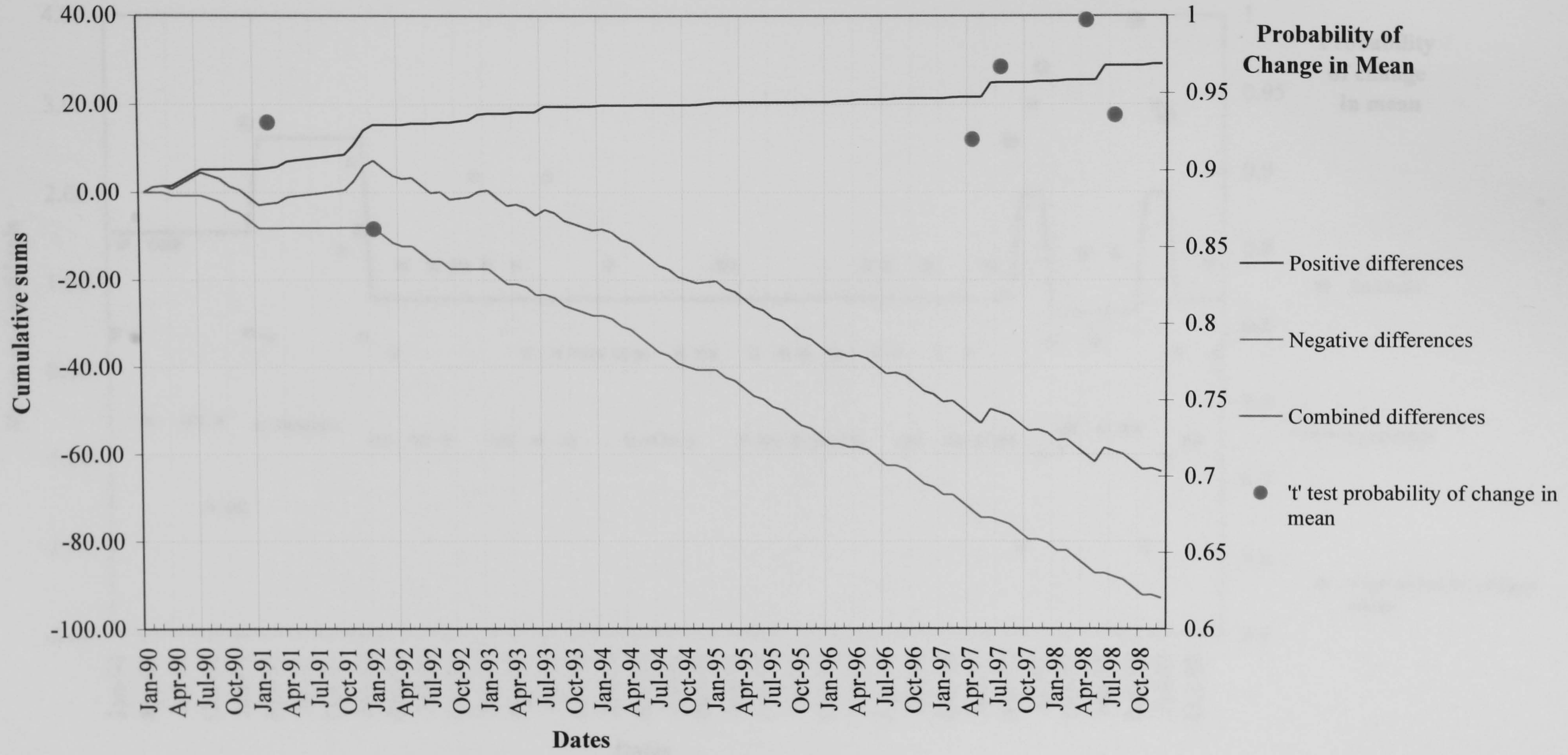
Cumulative sums Reportable Accidents
(changes less than 0.5 standard deviations neglected)
Cumulative sums
40.00
20.00
0.00
-20.00
-40.00
-60.00
-80.00
-100.00
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Probability of Change in Mean
Positive differences
Negative differences
Combined differences
't' test probability of change in mean
Jan-90
Apr-90
Jul-90
Oct-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jan-93
Apr-93
Jul-93
Oct-93
Jan-94
Apr-94
Jul-94
Oct-94
Jan-95
Apr-95
Jul-95
Oct-95
Jan-96
Apr-96
Jul-96
Oct-96
Jan-97
Apr-97
Jul-97
Oct-97
Jan-98
Apr-98
Jul-98
Oct-98
Dates

Figure 8

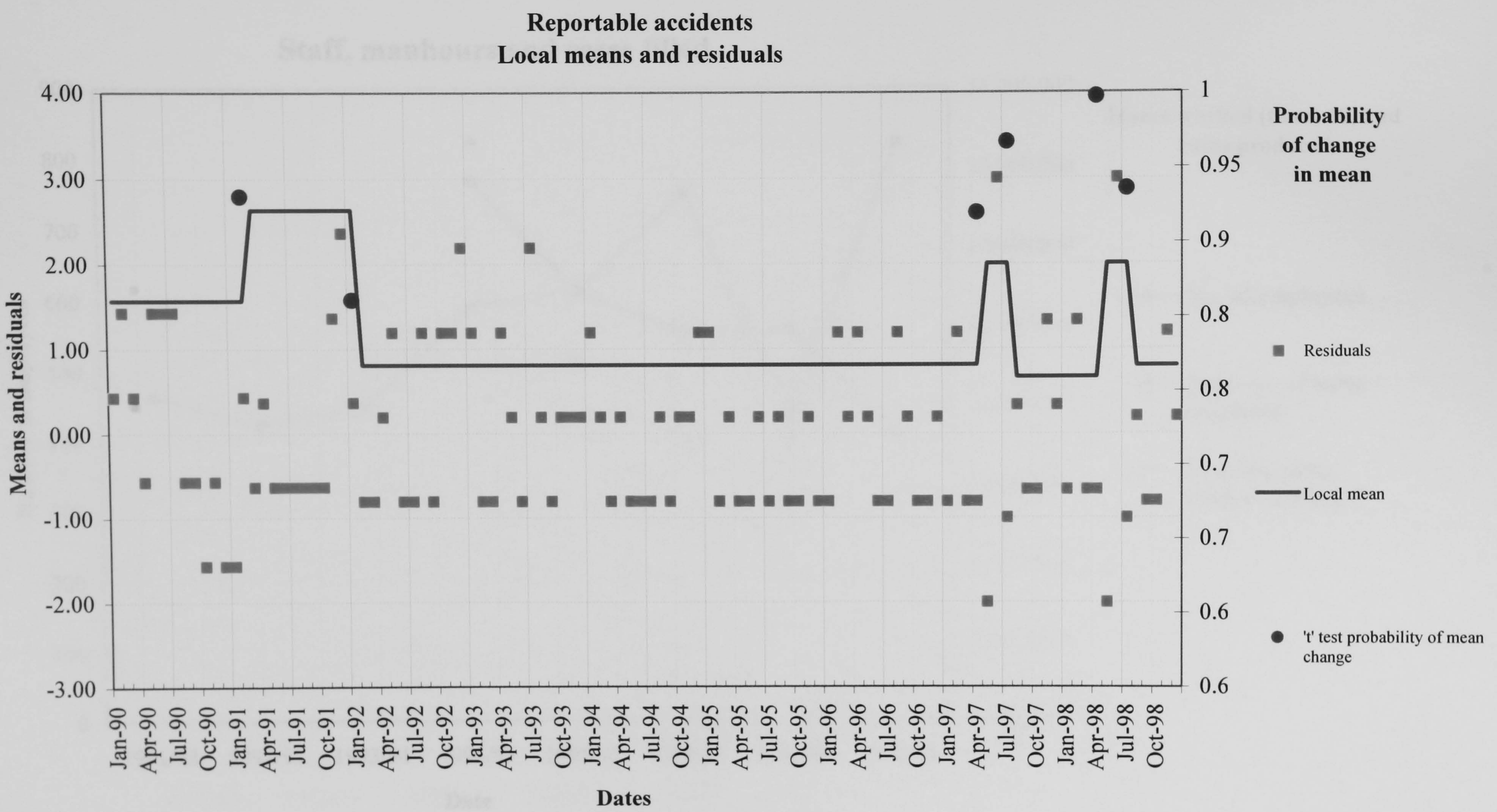
Reportable accidents
Local means and residuals
Means and residuals
Probability of change in mean
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
1
0.95
0.9
0.8
0.8
0.7
0.7
0.6
0.6
Residuals
Local mean
't' test probability of mean change
Jan-90
Apr-90
Jul-90
Oct-90
Jan-91
Apr-91
Jul-91
Oct-91
Jan-92
Apr-92
Jul-92
Oct-92
Jan-93
Apr-93
Jul-93
Oct-93
Jan-94
Apr-94
Jul-94
Oct-94
Jan-95
Apr-95
Jul-95
Oct-95
Jan-96
Apr-96
Jul-96
Oct-96
Jan-97
Apr-97
Jul-97
Oct-97
Jan-98
Apr-98
Jul-98
Oct-98
Dates

Figure 9

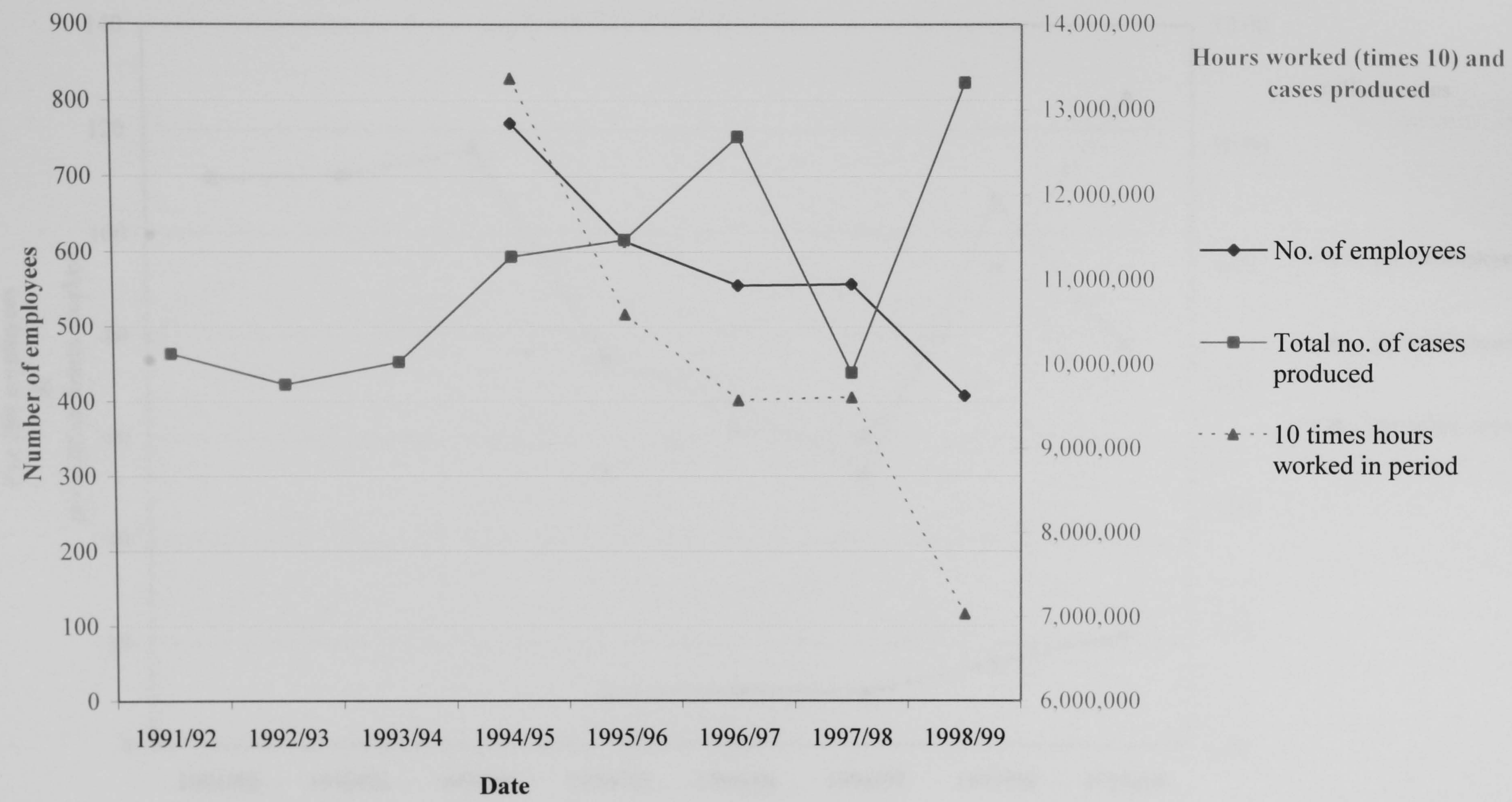
Staff, manhours and cases filled
900
800
700
600
500
400
300
200
100
0
Number of employees
14,000,000
13,000,000
12,000,000
11,000,000
10,000,000
9,000,000
8,000,000
7,000,000
6,000,000
Hours worked (times 10) and cases produced
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
Date
No. of employees
Total no. of cases produced
10 times hours worked in period

Figure 10

Minor injuries

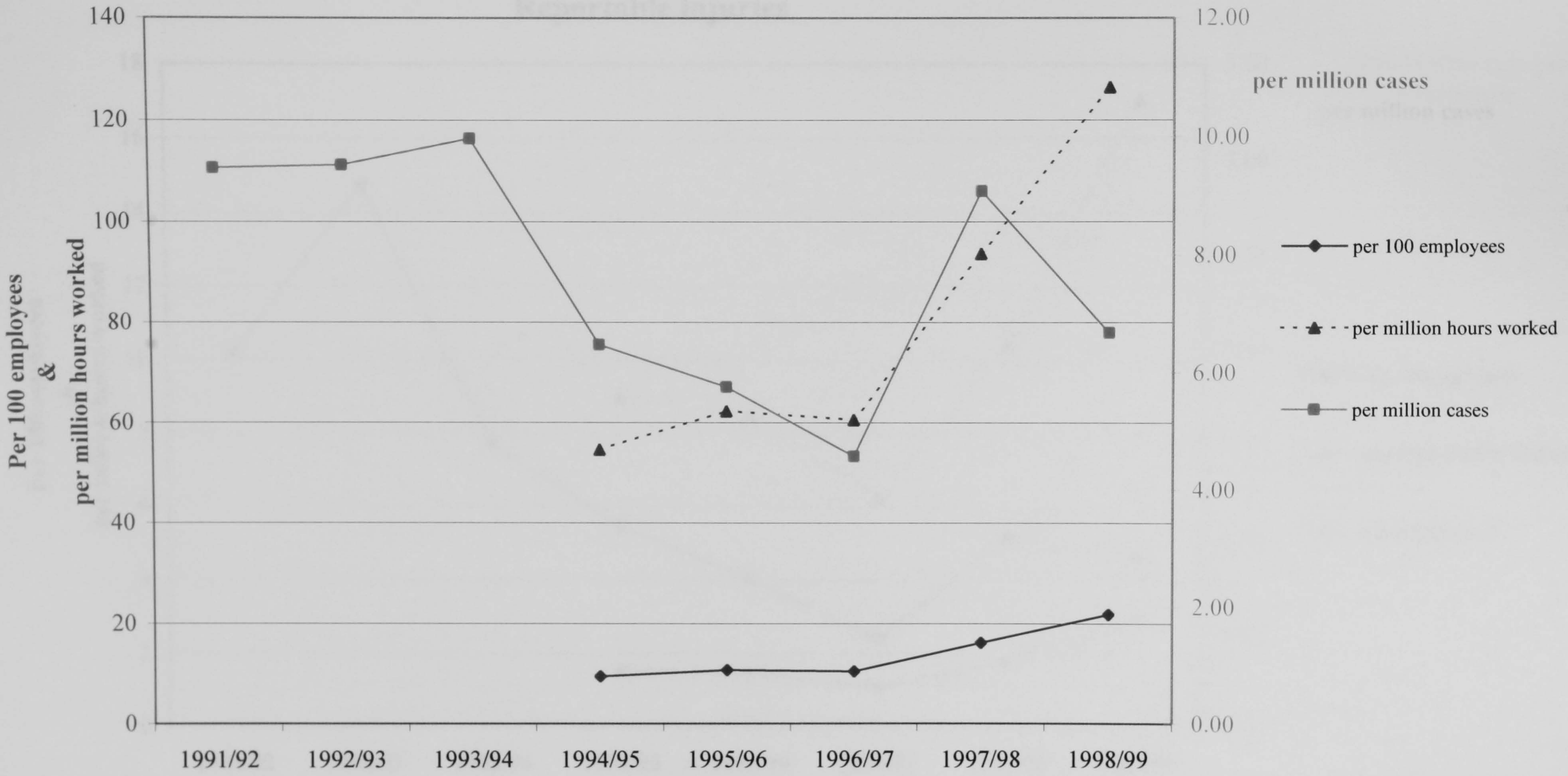

Figure 11

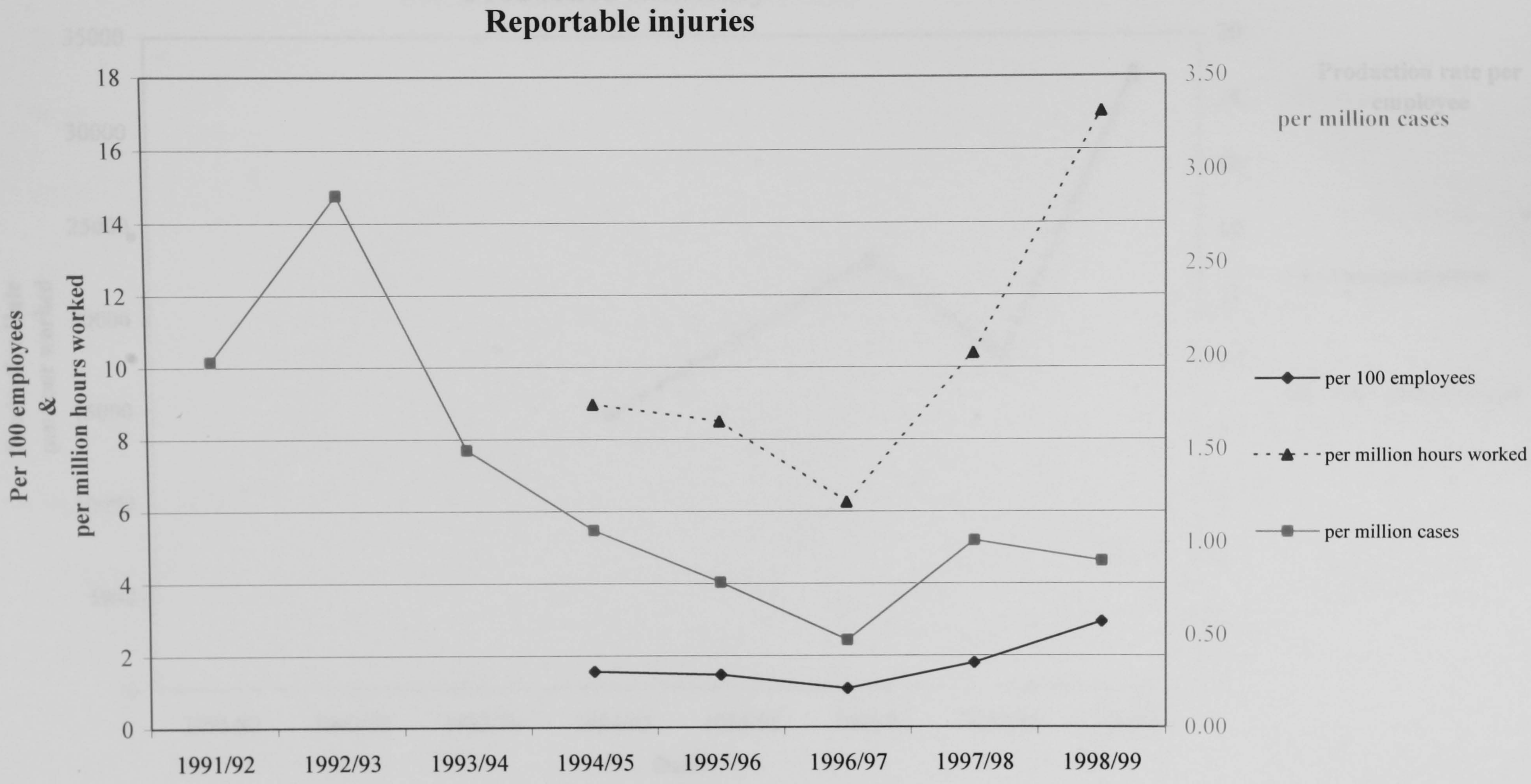
Reportable injuries
Per 100 employees
&
per million hours worked
per million cases
18
16
14
12
10
8
6
4
2
0
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
per 100 employees
per million hours worked
per million cases

Figure 12

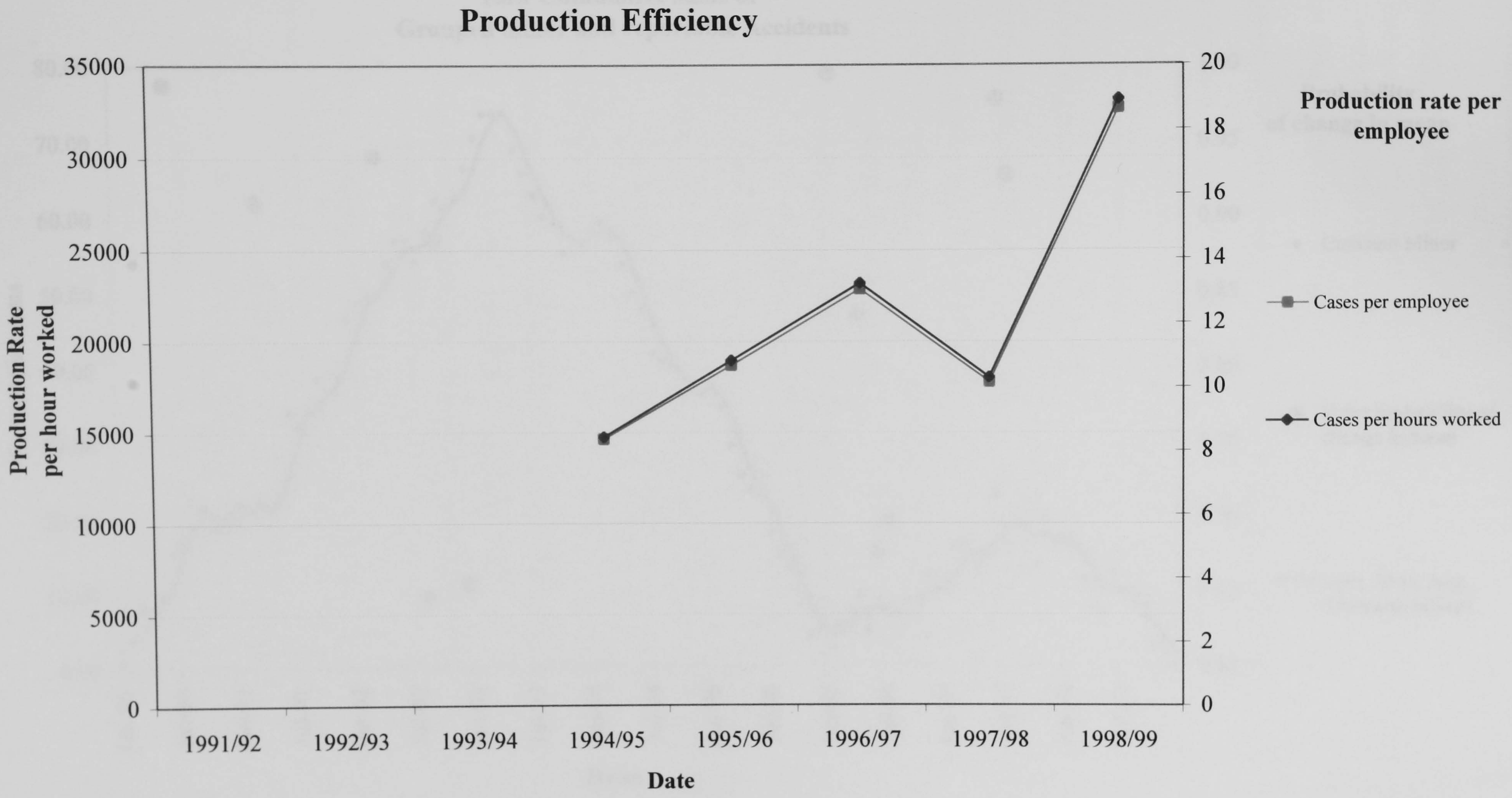
Production Efficiency
Production Rate per hour worked
35000
30000
25000
20000
15000
10000
5000
0
20
18
16
14
12
10
8
6
4
2
0
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
Date
Production rate per employee
Cases per employee
Cases per hours worked

Figure 13

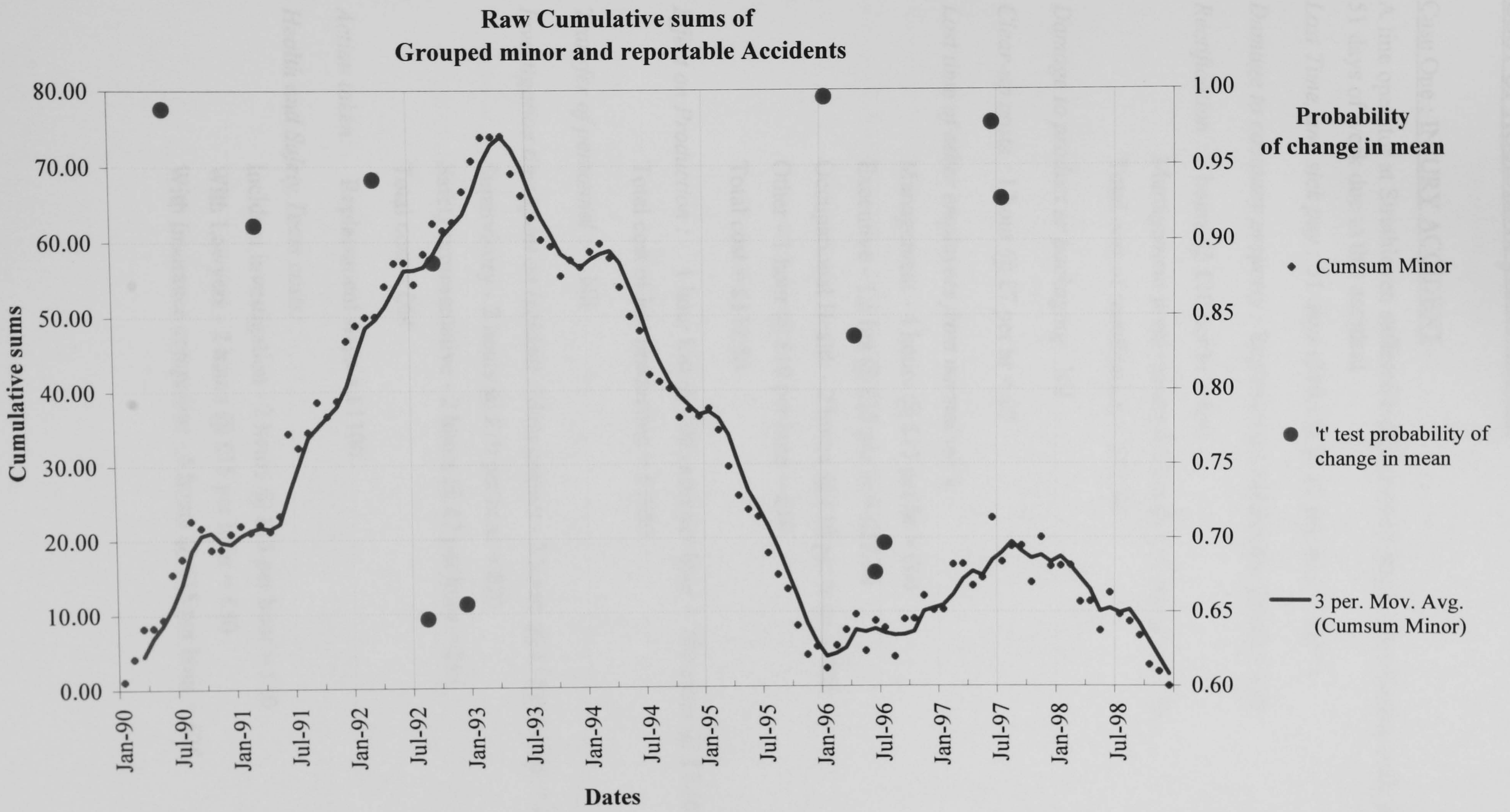
Raw Cumulative sums of
Grouped minor and reportable Accidents
Cumulative sums
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
Probability
of change in mean
Cumsum Minor
't' test probability of
change in mean
3 per. Mov. Avg.
(Cumsum Minor)
Jan-90
Jul-90
Jan-91
Jul-91
Jan-92
Jul-92
Jan-93
Jul-93
Jan-94
Jul-94
Jan-95
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Dates

Figure 14

COST OF ACCIDENTS CASE STUDIES

Case One : INJURY ACCIDENT

A line operator at Strathleven suffered badly crushed fingers and subsequently lost 51 days of work due to this accident.

Lost Time, and sick pay : 51 days (390.15) @ £7 per hour = £2731

Damage to company property : Replacement Machinery Guard = £10

Rectification : 3 hours @ £10 per hr = £30

Management involvement 0.5 hrs @ £15 per hr = £7.50

Total cost of rectification = £37.50

Damage to product or packaging : Nil

Clear-up costs : 1 hour @ £7 per hr = £7

Lost time of other employees from normal work:

Management - 4 hours @ £15 per hr = £60

Executive - 1.5 hrs @ £15 per hr = £22.50

Occupational Health - 2 hours @ £10 per hour = £20

Other - 1 hour @ £10 per hour = £10

Total cost = £112.50

Effect on Production : 1 hour lost @ 700 cases per hour = 700 cases @ £1.50 each

Total cost of lost production = £1050

Transfer of personnel : Nil

Investigation time spent on incident : Management - 2 hours @ £15 per hour = £30

Supervisory - 2 hours @ £10 per hour = £20

Safety representative - 2 hours @ £7 per hour = £14

Total cost = £64

Action taken: Replacement steps = £1100

Health and Safety Team costs:

Incident investigation - 2 hours @ £15 per hour = £30

With Lawyers - 2 hours @ £15 per hour = £30

With Insurance companies - 5 hours @ £15 per hour = £75

FIGURE 15

In negotiations with the injured party - 1 hour @ 15 per hour = £15

Total cost = £150

Other costs : Taxi to take the injured to hospital = £2

Insurance reserve placed against this accident by Commercial Union :

Reserve = £20,000

TOTAL UNINSURED COST OF THIS ACCIDENT = £15,264

Case Two : Near Miss INCIDENT

Units 1 and 2 were evacuated due to a suspected gas leak.

Damage to company property : Nil

Damage to product or packaging : Nil

Clear-up costs : Nil

Lost time of employees from normal work (minimum 1.5 hours):

Management - Total of 15 hrs @ £15 per hour = £225

Executive - Nil

Occupational Health - Nil

Others - (190 employees @ 1.5 hours) @ £10 per hour = £1995

Total cost = £2220

Effect on Production :

1.5 hours lost = ~ 7000 cases @ £1.50 per case (fixed cost per case)

Total cost of lost production = £10,500

Transfer of personnel : Nil

Investigation time spent on incident : Accounted for under lost time from normal work

TOTAL UNINSURED COST OF THIS ACCIDENT = £12,720

FIGURE 15

EXAMPLE TRAINING MATRIX

Training Course	Shopfloor & Operators	First Aiders, Security, Fire Team	Safety Rep	Safety Co-ordinators	Supervisors & Line Managers	Exec/ Senior Manager	Safety Specialists	Engineering/ Facilities	Specific Relevant Employees (as identified)
Safety Induction	X	X	X	X	X	X	X	X	X
Job/ Task training – provide competence to do a job, including safe systems of work, responsibilties, all aspects of EHS	X	X	X	X	X	X	X	X	X
NEBOSH or Industry specific Health & Safety Certificate			X	X			X		X
NEBOSH Environmental Certificate/ Diploma				X			X	X	X
Professional Competency in OHS							X		
Technical specialist training as required – e.g confined space entry, electrical, hot work, scaffolding, FLT licence	X	X	X	X	X	X	X	X	X
Other training and competency to meet Statutory requirements	X	X	X	X	X	X	X	X	X
Safety modules for Managers			X	X	X		X		
Safety modules for safety reps			X						
TUC Safety Representatives			X						
EHS Policy	X	X	X	X	X	X	X	X	X
EHS Roles & Responsibilities	X	X	X	X	X	X	X	X	X
Risk Assessment		X	X	X	X		X	X	
Accident and Incident Investigation process		X	X	X	X	X	X	X	X
Change/ Project Management				X	X	X	X	X	X
Hazard Spotting/ Notification	X	X	X	X	X	X	X	X	X

FIGURE 16

EXAMPLE TRAINING MATRIX

Training Course	Shopfloor & Operators	First Aiders, Security, Fire Team	Safety Rep	Safety Co-ordinators	Supervisors & Line Managers	Exec/ Senior Manager	Safety Specialists	Engineering/ Facilities	Specific Relevant Employees (as identified)
Risk awareness	X	X	X	X	X	X	X	X	X
Behavioural Safety (program)	X	X	X	X	X	X	X	X	X
Workplace Safety Inspection	X	X	X	X	X	X	X	X	X
Safety Auditing			X	X	X	X	X		
Effective Problem Solving			X	X	X	X	X	X	X
Effective Team work			X	X	X		X		
Environmental Appreciation	X		X	X	X	X	X	X	
Occupational Health awareness		X		X	X		X		X
COMAH Regulations awareness	X	X	X	X	X	X	X	X	X
COMAH Regs/ Safety Reports				X	X	X	X	X	X
Permit to Work (Management)				X	X		X	X	X
Permit to Work (Work under)			X					X	X
Control of contractors (Management)				X	X		X	X	
Confined Space Entry (Mgt)		X		X	X		X	X	
Confined Space Entry (work)		X					X	X	X
Emergency Action for confined space response		X		X	X		X	X	X
HACCP Product Safety Analysis	X			X	X		X		X
Scaffold Safety Inspection				X			X	X	X
Electrical Safety appreciation				X			X	X	X
Electrical Equipment in explosive atmospheres				X	X		X	X	X
IEE 16th Edition Wiring Regulations								X	X

FIGURE 16

EXAMPLE TRAINING MATRIX

Training Course	Shopfloor & Operators	First Aiders, Security, Fire Team	Safety Rep	Safety Co-ordinators	Supervisors & Line Managers	Exec/ Senior Manager	Safety Specialists	Engineering/ Facilities	Specific Relevant Employees (as identified)
Use of Gas Monitors							X	X	X
Radiation Protection							X	X	X
Fork Lift Truck management & Vehicle safety			X	X	X		X		X
PUWER (machinery & work equipment) assessment				X	X		X	X	X
Pressure Vessels							X	X	X
Chemical Management / COSHH	X	X	X	X	X		X	X	X
Manual Handling risk assessment	X		X	X	X		X	X	X
Manual Handling technique	X							X	X
First Aid at Work Certificate		X							X
First Aid refresher		X							X
Fire Team Training		X							X
Fire Evacuation procedures	X	X	X	X	X	X	X	X	X
Fire Awareness & use of extinguishers	X	X	X	X	X	X	X	X	X
Use of Breathing Apparatus		X							X
Crisis awareness					X	X	X		X
Crisis Calls Handling					X				X
Crisis Management Process					X	X	X		
Noise Exposure	X	X	X	X	X	X	X	X	X
Display Screen Equipment use	X	X	X	X	X	X	X	X	X
Personal Protective Equipment Use	X	X	X	X	X	X	X	X	X

FIGURE 16 b