An analysis of fatal accidents in agriculture in Great Britain.

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Doctor of Philosophy

THE UNIVERSITY OF ASTON IN BIRMINGHAM

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Summary

The number of fatal accidents in the agricultural, horticultural and forestry industry in Great Britain has declined from an annual rate of about 135 in the 1960's to its current level of about 50. Changes to the size and makeup of the population at risk mean that there has been no real improvement in fatal injury incidence rates for farmers.

The Health and Safety Executives' (HSE) current system of accident investigation, recording, and analysis is directed primarily at identifying fault, allocating blame, and punishing wrongdoers. Relatively little information is recorded about the personal and organisational factors that contributed to, or failed to prevent accidents. To develop effective preventive strategies, it is important to establish whether errors by the victims and others, occur at the skills, rules, or knowledge level of functioning; are violations of some rule or procedure; or stem from failures to correctly appraise, or control a hazard.

A modified version of the Hale and Glendon accident causation model was used to study 230 fatal accidents. Inspectors' original reports were examined and expert judgement applied to identify and categorise the errors committed by each of the parties involved.

The highest proportion of errors that led directly to accidents, occurred whilst the victims were operating at the knowledge level. The mix and proportion of errors varied considerably between different classes of victim and kind of accident. Different preventive strategies will be needed to address the problem areas identified.

This research showed that a modified version of the Hale and Glendon model could be used retrospectively to study a group of fatal accidents. The findings provide valuable information for the development of agricultural accident prevention programmes. Future studies should ideally use the technique in conjunction with Events and Causal Factors analysis.

Keywords

Causation Models, Hale and Glendon, Human factors,

Dedication

To the memory of Saul Ben Randall.

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Abbreviations

ACSNI	- Advisory Committee on the Safety of Nuclear Installations
APAU	- Accident Prevention Advisory Unit
ATB	- Agricultural Training Board (now ATB Landbase)
ATV	- All Terrain Vehicle
COFFIN	- COnstruction and Factories Fatal INjury database
ECF	- Events and Causal Factors analysis
HSC	- Health and Safety Commission
HSE	- Health and Safety Executive
LFS	- Labour Force Survey
MAFF	- Ministry of Agriculture Fisheries and Food
MORT	- Management Oversight and Risk Tree
NADOR	- Notification of Accidents and Dangerous Occurrences Regulations 1980
NIOSH	- National Institute of Occupational Safety and Health
NSC	- National Safety Council
NTOF	- National Traumatic Occupational Fatalities, database
pto	- power take-off
RHI	- Revised Huffman Inventory
RIDDOR	- Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985 and 1995
ROPS	- Roll Over Protective Structure
RTA	- Road Traffic Accidents
WHO	- World Health Organisation

Contents

Chapter 8 Conclusions

List of Tables and Figures

Tables and Figures following Chapter 5

Chapter 1. Introduction

1.0 Background to the study

Nine hundred and thirty-nine persons received fatal injuries as a result of accidents in agriculture in the fourteen year period 1979-1992. The purpose of this thesis is to analyse the causal factors associated with these fatal accidents in order to provide improved guidance on accident prevention to the industry and to the Agricultural Inspectorate (part of the Health and Safety Executive (HSE)).

Underlying the purpose of the thesis is the belief that agricultural accidents in particular, and occupational accidents generally, are not sufficiently or appropriately analysed, particularly in terms of 'human factors'. Largely for this reason, the preventive actions recommended by HSE may not take adequate account of the behavioural aspects of accident causation. For example, a prevention initiative is likely to fail if the primary causal factor is assumed to be shortcomings in competence, when the personnel at risk are, in fact, competent but lack sufficient or the appropriate motivation.

Prevention programmes and safety training plans need to be based on empirical evidence showing, for example, the relative importance of, and relationships between, the following causal factors in accident causation:

- failures to identify hazards;
- failures to assess risks accurately;
- failures to take personal responsibility for action;
- failures to take appropriate preventive action;

- shortcomings in competence (leading to unintended errors) compared with shortcomings in motivation (leading to risk taking/violations);

- errors and/or violations made or committed by the injured or deceased person;

- errors and/or violations made or committed by other parties, for example, fellow workers, supervisors, and suppliers of equipment;

- differences in the pattern of errors and/or violations made by, or in accidents involving, for example, younger and older workers, employees, children, and the self-employed.

The purpose of this thesis is to analyse fatal accidents in agriculture in order to obtain empirical data to prioritise and relate factors such as those just listed, in order to improve the quality and relevance of preventive programmes.

In Great Britain the Health and Safety Executive (HSE) collects detailed information about all agricultural (including horticultural and forestry) fatal accidents. For many years Agricultural Inspectors have investigated all fatalities, often acting as expert advisers to HM Coroners. Following investigation Inspectors complete a report, detailing the circumstances in which the deceased met their death, and other information revealed at the inquest.

Many factors combine to influence what is recorded in the Inspector's report: the resources available to carry out the investigations, the training and experience of the Inspector conducting the investigation, the availability of witnesses and their perceptions of the Inspector. The way in which the inquest is conducted will have a bearing upon the facts revealed in the investigation and recorded in the report. Reports are completed using a standard form on the first part of which basic factual information is recorded, such as the name of the deceased and the date time and place at which they met their death. The second part of the form consists of a free text area in which conventionally, Inspectors summarise the evidence presented by each witness at the inquest, drawing out the points which they feel are important. The format of the forms has varied slightly over the years but there has always been provision for the investigating Inspector to record their expert opinion as to why the accident happened. Unfortunately the expression of these opinions appears at times to have been constrained by fears (perhaps more imagined than real) about their possible disclosure during civil proceedings. Thus some information of use to researchers may have been lost. This is a frequent feature of research in which data collected for one purpose is subsequently analysed from a different perspective.

Since 1981 a brief factual account of all occupational fatalities has been stored in HSE's main computer system, potentially making routine analyses much easier. Again a number of factual variables are recorded, this time in coded format, followed by a brief narrative account of each accident's antecedents. Little information on human factors is recorded in a structured way, and what there is, is geared towards the allocation of blame. Some human factors information is available within the narratives. Relatively little use has been made of this potentially valuable store of information for accident prevention purposes. What analyses have been carried out have been principally restricted to examinations of variables such as age, gender, and employment status, date, time, and place of the accident, and an account of what happened.

Systematic examinations of accident aetiology have not been undertaken, e.g. through analyses of the human, organisational, and environmental factors that could have resulted in a particular person having a given accident, at a specific time and succumbing to the injuries sustained.

This research arose out of some initial analyses of agricultural fatal accidents carried out in the early 1980s. These analyses were initially undertaken simply to test newly acquired computer programming skills. A dissatisfaction with the available data led to a desire to explore whether it was possible, by the adoption of a more systematic approach to accident investigation, data collection and analysis, to gain more useful information for accident prevention purposes.

The research involved a comparison of the circumstances in which a sample of 230 individuals who were killed during agricultural (including horticultural and forestry) operations, and utilised an accident causation model. A modified Hale and Glendon model (Hale and Glendon, 1987) was used. This thesis seeks to demonstrate the utility of the modified Hale and Glendon model as a free-standing method of accident analysis, and describes the results obtained from its use. Further minor analyses aimed at increasing understanding of why accidents happen are also reported, as are recommendations for further data collection.

1.1 Historical context

The accidental deaths of people engaged in agricultural work have occurred since humankind first grew crops in the 'fertile crescent', about 10,000 BC. What have varied throughout history are the prevalence and kinds of accidents. As technology advanced, some types of accident have ceased to happen, whilst others have become more common. For example Howkins (1981) referring to farm work in Victorian times, states that :

> *' 'Harvest took a terrible toll'. Every year boys 'riding holdya' fell from the horses and were crushed under the wagon wheels, and a scythe or an unguarded binder could cause a terrible wound which often went untreated and led to death.'*

Wounds no longer go untreated, yet in Shropshire in 1979, a farmer died of tetanus following a cut from a scythe. Boys are still run over, but now they fall from tractors.

Legislation relating to the safety of people at work was first enacted in Great Britain in the mid 19th Century, but the law initially applied only to workers in factories and mines. Early legislation designed to protect people engaged in agricultural activities from harm arising from accidents, included the Threshing Machines Act, 1878, (Board of Agriculture and Fisheries 1878) and the Chaff-Cutting Machines (Accidents) Act, 1897 (Board of Agriculture and Fisheries 1897). These Acts provided for the secure fencing of Threshing and Chaff-Cutting Machines so as to prevent injury. They made provision for a penalty of £5 to be imposed and gave Police Constables the power to enter premises to see whether the Acts were being complied with. The Chaff-Cutting Machines (Accidents) Act of 1897 required among other things that 'so far as is reasonably practicable' the feeding mouths of chaff-cutting machines be guarded. These provisions were apparently not fully effective in preventing injuries for in 1906 the Board of Agriculture and Fisheries in their Leaflet No 177 (Board of Agriculture and Fisheries, 1906) stated that:

> *'Several cases in which serious accidents have occurred owing to the insufficient fencing of farm machinery have been brought to the notice of the Board, and they think it therefore advisable to draw the attention of farmers and others to the necessity for taking precautions against such accidents'*

The first comprehensive legislation aimed specifically at protecting those engaged in agricultural work, and which established an Inspectorate to enforce the provisions, did not reach the statute books until 1956. The Agriculture (Safety, Health and Welfare Provisions) Act 1956 provided for the introduction of regulations to protect people at work. A number of Regulations were made under the Act, for example relating to the safeguarding of power take-off shafts, circular saws, field and stationary machinery, ladders and to children.

Health and Safety legislation applying to Factories has for many years contained a provision requiring notification by employers to the Factories Inspectorate of certain injuries arising out of work-related accidents. There was no parallel provision applying to the agricultural industry prior to the introduction of the 'Notification of Accidents and Dangerous Occurrences Regulations 1981' (NADOR). Agricultural Inspectors did receive, often belatedly, information about accidents to employees via compensation claims made to the Department of Health and Social Security. NADOR applied to all occupations covered by the Health and Safety at Work etc. Act 1974. Despite the fact that there had been no requirement for farmers to notify accidents before 1980, the Inspectorate did hear promptly about all fatalities. This was because of a provision in the Agriculture (Safety, Health and Welfare Provisions) Act 1956, which states that HM Coroners shall adjourn any inquest on the body of a person whose death may have been caused by an accident occurring in the course of agricultural operations, unless an Inspector is present to watch the proceedings. The Coroner must give the Inspector at least twenty-four hours notice of the time and place where such an inquest is to be held. This provision has resulted in virtually 100 per cent of agricultural fatalities since that time being brought to the attention of the Inspectorate. Any fatalities not reported have usually come to the attention of local Inspectors through the press or local contacts.

1.2 Size and nature of the agricultural labour force

Recent improvements in the efficiency of farm work have arisen from increased mechanisation and larger field sizes, combined with increased productivity brought about by advances in plant and animal breeding. This increased efficiency has resulted in rapid changes in the size and nature of the agricultural labour force. The smaller number of people who are still required on farms need to be highly skilled, and responsive to change.

In 1960 the agricultural population in Great Britain was 1,050,000, but by 1991 this had almost halved, to 570,500. This decline has been accompanied by a shift in the makeup of the workforce from predominantly employees, to mainly self-employed people, and by a movement from full-time, to part-time employment, with casual workers and contractors used to cover seasonal work peaks.

Errington (1985) examined Ministry of Agriculture Fisheries and Food (MAFF) census data for England and Wales and concluded that although the total number of people working on farms had declined less during the 1970s than in the 1960s (2% compared with 6%), the aggregate decline concealed important variation between the groups that made up the workforce. Specifically, Errington noted a trend away from full-time male workers, with their labour being replaced by a combination of contractors (by means of which farmers could draw on a wider pool of specialised skills), family workers, and part-time and casual workers. He noted that during the period 1977-85, the number of regular whole-time hired male workers declined at the rate of almost 3%, or about 3,600 jobs, each year.

Ball (1986) commenting on the changes in the makeup and size of the workforce highlighted by Errington concluded

> *'What this amounts to is a significant partial restructuring of the agricultural labour force away from regular work forms towards essentially 'casual' employment relationships.'*

More recent data from the Ministry of Agriculture Fisheries and Food (MAFF, 1992) suggests that these and other changes have continued at an increasing rate throughout the 1980s (See Table 1.1). Between 1982 and 1991 the agricultural population comprising farmers, spouses, managers and other workers on farms in Great Britain declined from 645,500 to 570,500, a fall of almost 12%. This decline has continued during the 1990's although at a slightly slower rate. The 'Review of Agriculture in the United Kingdom 1995' (MAFF, 1996) records a decline in the total labour force of about 1% between 1994 and 1995, which is stated to be roughly the same rate as in the previous three years.

Total Labour Force (000's)	1982	1991	% Change 1982/1991
England	510.1	444.9	-12.8
Scotland	68.9	61.1	-11.3
Wales	66.5	64.5	-3.0
Total - Great Britain	645.5	570.5	-11.6

Source - MAFF (1992)

Table 1.1 Changes in the size of the agricultural labour force 1982 - 1991

The overall percentage decline in the labour force was much less in Wales than in either England or Scotland. Indeed at the start of the period the farm labour force in Scotland was larger than that in Wales, but by the end of the decade the situation had reversed.

The decline in the size of the agricultural population was not evenly spread among the groups making up the population. Table 1.2 illustrates the changes in the various groups.

In the case of farmers, the overall decline in numbers in Great Britain during the period 1982 - 1991 was about 5%. In Wales this reduction was only 1%, whilst in Scotland the number of farmers actually rose by 1%. The most striking rise in any group of people working on farms in Great Britain was the number of spouses now actively involved in the work of the farm. Here an overall rise of 4.5% was made up of a 1% fall in England (much less than the 6% fall in farmers) which was countered by an 11%

rise in Wales and a 30% increase from 8,000 to 10,400 in Scotland. The Ministry of Agriculture's June Census is designed to record spouses only when they are economically active on the farm. Because of the current tax regime in Great Britain many spouses (primarily wives) supply a variable amount of mainly secretarial support in return for which their pay is allowable against tax. A farmer claiming a tax allowance for a spouse would naturally not wish to appear inconsistent by saying that the spouse was not economically active on the farm, when completing the June Census return for MAFF. The figures for spouses who are active on farms are thus susceptible to bias but as the tax situation has remained unchanged for many years any bias should have remained fairly constant.

GREAT BRITAIN (000's)	1982	1991	% Change 1982/1991
Total - Labour Force	645.5	570.5	-11.6
Farmers	256.1	244.3	-4.6
Spouses	68.8	71.9	4.5
Managers	8.0	7.9	-1.3
Other Workers	312.6	246.4	-21.2
Regular family - Total	46.5	41.0	-11.8
Whole-time	30.7	25.1	-18.2
Part-time	15.8	16.0	1.3
Regular hired - Total	173.2	127.1	-26.6
Whole-time	132.7	89.5	-32.6
Part-time	40.4	37.4	-7.4
Seasonal/ casual	92.8	78.5	-15.4

Source - MAFF (1992)

Table 1.2 Changes in the groups making up the agricultural workforce 1982 - 1991

The number of regular family workers has declined by 11.8% in Great Britain over the period 1982-1991, with a larger decline in whole-time family workers and a slight rise in family members working part-time on farms. The picture for Great Britain masks considerable variations in the percentages in the constituent countries. In Scotland the number of whole-time family workers declined by 43%, and the number of part-timers by 9%. In England whole-time family workers declined by 8%, whilst the number of part-time workers rose by almost 1%. In Wales there were 700 (21%) less whole-time family workers at the end of the decade, but 300 (16%) more part-timers.

The number of regular hired workers found on farms has also declined, the overall fall being even more pronounced than for regular family workers. The MAFF statistics record a decline for Great Britain over the period 1982-1991, of almost 27%, made up of 33% whole-time, 7% part-time and 15% casuals. Here again the overall figure disguises wide variations in the individual countries. In England there were 37,000 less full-time hired workers (a fall of 32%), at the end of the period, whilst the number of part-timers had declined by 7% and casuals by 15%. In Scotland and Wales the numbers are much smaller but show a similar pattern of a major shift out of full-time agricultural work, with a proportionately smaller decline in part-time and casual workers.

The numbers of casual workers found on farms varies considerably throughout the year in response to peaks and troughs in the amount of work to be done. Casual labour would be employed principally for handwork rather than for work demanding the use of machinery. Typical examples would include fruit picking, vegetable harvesting (including potatoes) and hay and straw carting. Here again increased mechanisation has led to a reduced demand for the large gangs of casual workers that used to be common. Peas are now almost exclusively harvested by machine, and sold frozen in bags, rather than being hand picked for sale in the pod. Fruit trees and bushes are pruned in new ways so as to facilitate the use of mechanical harvesters.

Ball (1986) found that because the MAFF census takes place on the first weekday of June, the numbers of 'seasonal or casual' workers recorded was likely to vary from year to year because of the vagaries of the climate. He also pointed out that the peak period for the employment of seasonal labour was from July to September. Ball also described a survey that he had undertaken into the use of seasonal or casual labour on 211 randomly selected farms in Wales and the Midlands, and concluded that

> *'....the MAFF Census records only to 20% [sic] of the full extent of directly-recruited seasonal or casual labour and labour indirectly supplied by contractors.'*

In 1993 the MAFF Census (MAFF, 1994) recorded just over 76,000 casual workers on farms in Great Britain. The most recent data, for 1995 (MAFF, 1996) records an increase of 2% in seasonal or casual workers which is *'.....against the trend of recent years.'*

1.3 Recent agricultural accident history

A number of factors combine in the agricultural industry to make some hazards and risks different to those in other industrial sectors. The normal range of industrial hazards such as machinery, working at height, electricity and chemicals are all found on farms, together with the additional hazard of animal handling. On farms, the risks may be increased by environmental factors such as the weather, and the seasonal nature of some tasks. In addition the industry has, as previously mentioned, undergone many changes. The Victorian image of friendly shire horses pulling haywains, and gangs of mowers armed with scythes relaxing in the sunshine in corn fields, whilst drinking rough cider, may have been partly true in the 1940s, but now has gone for ever.

The characteristics of the victims of agricultural accidents differ from those injured in other industries. The population at risk in factories usually consists of people in the normal age range for members of the working population, 16 to 64 (currently 59 for women). But farms, in addition to being work sites, are also homes for the people who work there and their families. Thus we find the age range of victims of agricultural accidents is much wider than for accidents in other industries.

Pre-school children present at worksites and temporarily unsupervised drown in water troughs; school-age children playing in dens in straw stacks burn in fires; older children are injured operating machinery designed and guarded to a standard appropriate for adults; retired farmers and workers return to assist by driving tractors at busy times of the year, or get too near to animals and have accidents, perhaps because their reflexes are dulled by age.

Since the 1960s, the absolute number of those killed in agriculture has declined from around 135 in the mid 1960s, with a peak of 144 in 1971, to under 60 per year so far, in the 1990s (See Figure 1.1). However, this does not necessarily mean that farms have become safer places, because as mentioned above the numbers involved in the industry, and hence at risk, has also declined.

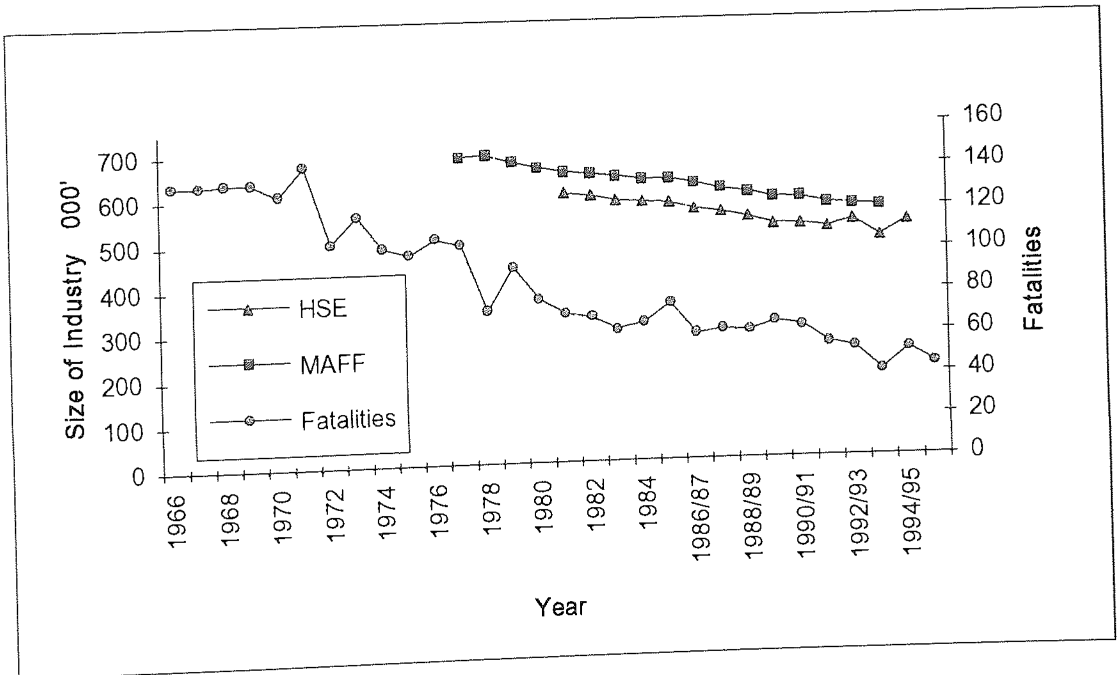


Figure 1.1 Fatalities in the Agricultural industry compared to its size

Figure 1.1 shows the extent of the fall in the number of fatalities together with the decline in the size of the industry. The fall in the number of fatalities may appear to provide evidence of an improving situation. However, the fall in the size of the industry should itself have led to a decline in the absolute numbers killed. The effect of this upon injury incidence rates will be discussed later in this Chapter.

In Figure 1.1 there are two sets of data showing the numbers engaged in agriculture. The figures published by the Ministry of Agriculture Fisheries and Food (MAFF 1973, 1975, 1980, 1981, 1986, 1991, 1992 and 1994), are calculated from the data collected in the annual June Census of agricultural holdings. The HSE figures are a combination of the numbers employed as recorded in the Department of Employment's annual 'Census of Employment' and the number of self-employed people estimated from the Labour Force Survey (LFS). HSE's official statistics are all related to the 'Census of Employment' and LFS data, in order to retain consistency across employment sectors. Note that the absolute figures differ by about 53,000, which arises from differences in definitions. Until 1985 fatalities were reported by calendar year, thereafter all official HSE statistics relate to financial years.

One means of assessing changes in the relative risk of agricultural work is to examine trends in injury incidence rates over time. Singleton et al (1981) stated that the fatal accident rate for farmers and employees, per 100,000 at risk had fallen from 22.7 in 1971 to 16.4 in 1980, although it is not clear how these figures were calculated. They also commented that:

> *'....the decrease in accident rate has not been as great as the decrease in the actual number of accidents would suggest.'*

1.4 Comparative fatality incidence rates.

Some idea of the relative risk of the agricultural industry may be gained, by comparing the fatal injury incidence rates for the industry, with those for other industry sectors in Great Britain. Figure 1.2 was prepared using data from the Health and Safety Executive (1992), and Health and Safety Commission (1993, 1996), amplified by further information from HSE's Statistical Services Unit. It shows the fatal injury incidence rates for a number of sectors of British Industry.

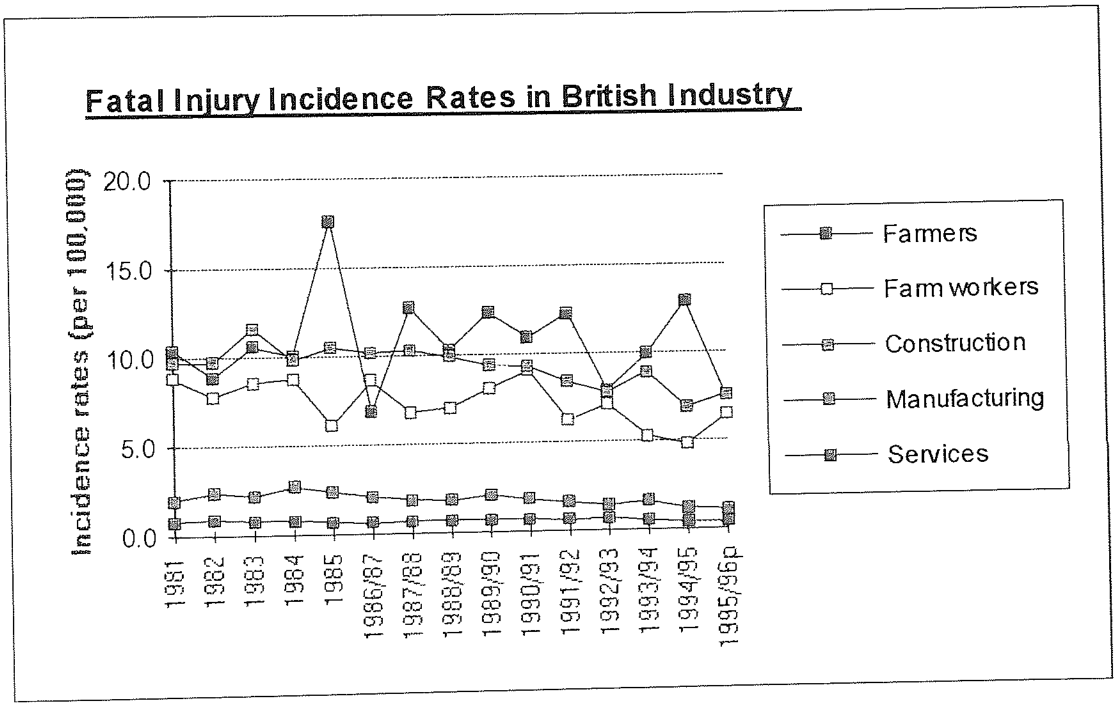


Figure 1.2 Recent fatal injury incidence rate

Figure 1.2 shows how the fatal injury incidence rates for the main industry sectors has varied since 1981. Injury incidence rates in the manufacturing and services sectors at about 2.0, and 0.7 respectively, are consistently lower than in construction or agriculture. During the decade from 1981 the mean fatal injury incidence rate for construction workers was 9.7 per 100,000, for agricultural workers 7.8, and for the self employed in the agricultural industry 10.9. During the period there were some quite wide variations in the injury rates, particularly for farmers and for farm workers.

The reason for these wide swings is probably due to the way in which the numbers within the industry are estimated. In particular the number people recorded as self-employed varies quite widely from year to year. These variations are illustrated in Table 1.3.

Year	Number of employees	Percentage change	Number of self-employed	Percentage change
1990/91	276,300	-	247,000	-
1991/92	269,400	-2.5%	247,000	0%
1992/93	256,300	-4.9%	274,800	+11.3%
1993/94	251,200	-2.0%	243,000	-11.6%
1994/95p	245,000	-2.5%	281,800	+16.0%

Table 1.3 Changes in the size of the agricultural workforce

1990/91 to 1994/95

Table 1.3 shows the last 5 years employment and self-employment figures as used by HSE to calculate fatal injury incidence rates for farmers and farm workers. The information was supplied by HSE's Statistical Services Unit (Statistical Services Unit, 1996). The number of employees calculated from the Department of Employment's annual 'Census of Employment' shows a gradual decline of between 2 and 5% per year during the period. Conversely the number of self-employed people as estimated from the Labour Force Survey (LFS) shows very wide variations, a fall of nearly 12% in 1993/94 being followed by a rise of 16%. However, as previously stated these figures have to be used to maintain consistency with the other industry sectors.

Such wide variations in the numbers of self-employed people in the agricultural industry are not consistent with the figures from the Ministry of Agriculture's June census (MAFF, 1994). For the three years up to 1991 these showed a decline of about 2,000 per year but have since increased at the rate of 2 to 3,000 per year. In the case of employees recorded in the

June Census, the figures are consistent with the 'Census of Employment' figures used by HSE, in showing a gradual decline in the numbers employed. Whilst the absolute numbers are not directly comparable because of differences in definitions, the figures should at least be moving consistently in the same direction.

In an attempt to iron out the variations in injury incidence rates published by HSE, a three year rolling average for the same data was calculated and is shown at Figure 1.3.

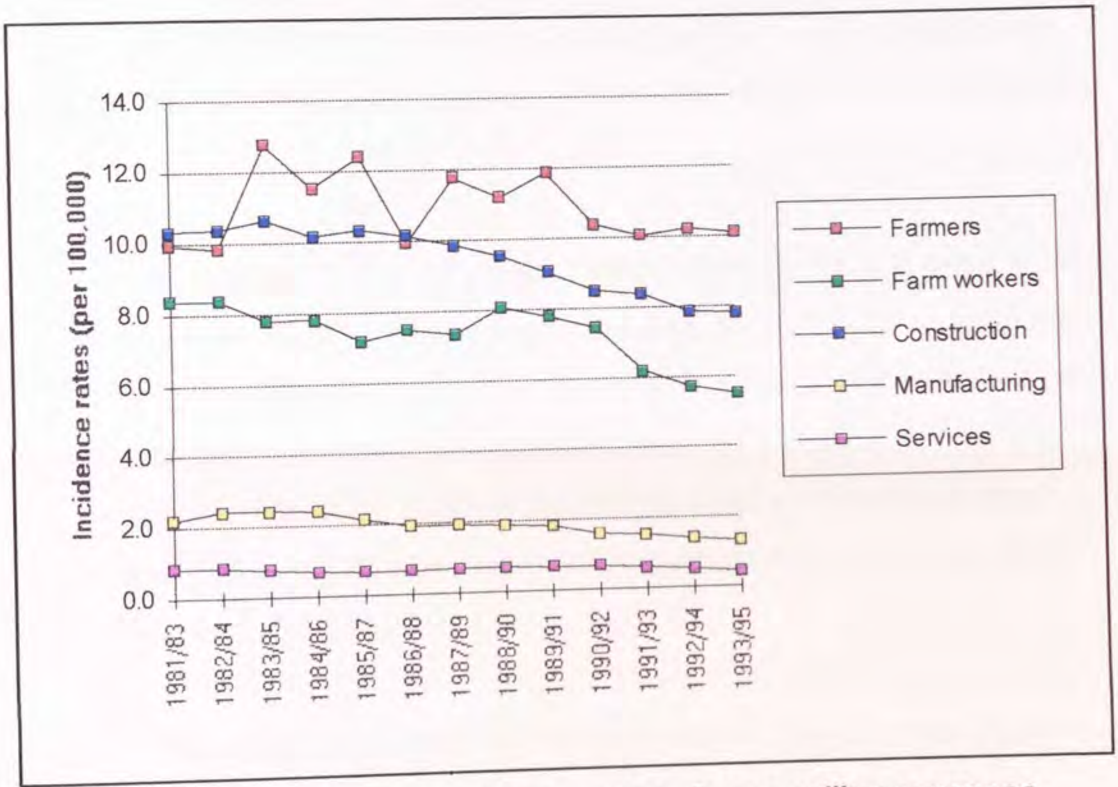


Figure 1.3 Fatal injury incidence rates- 3 year rolling averages

Figure 1.3 shows that during the period from 1981 to 1995, the fatal injury rate for construction workers has fallen from above 10 to below 8 per 100,000. In the same period that for farm workers declined from above 8 to below 6. The only sector among the industries shown not to have significantly reduced its fatal injury frequency rate is the self-employed in agriculture where the average for 1993/95 at 10.1 per 100,000, was marginally higher than the 9.9 in 1981/83.

Fatal injury incidence rates are calculated from the numbers killed in a particular employment category (employed or self employed), and the total number in the industry in the appropriate employment category, during the same time period. Such calculations, when applied to factory or office situations give a reasonably representative picture of the relative risk in each type of industry. This is however only true in industries where no, or few, third parties are killed (or injured) as a result of work activities. Agriculture, and to a slightly lesser extent construction, are unusual in that a significant number of third parties (residents, visitors, trespassers, passers-by etc.) are killed each year, as a result of the activities of those industries. Thus incidence rates for the self employed and for employees provide a less than adequate picture of the risks arising from the agricultural industry.

Historically in agriculture approximately 40% of those killed have been employees, about 40% self employed, and up to 20% have been third parties, mainly children. These proportions have gradually changed as the numbers of employees, and children killed have both declined. Over the five years from 1991/92 to 1995/96 about 36% of those killed have been employees, just over 51% self employed, and about 12% have been third parties, just over half children.

The third parties killed on farms form an extremely diverse group. The children may be: normally resident on the farm; visiting friends or relations; accompanying parents to work; visiting the farm as part of a formal or informal recreational activity; voluntarily assisting on the farm; trespassing; or visiting a 'pick your own' farm, to pick fruit or vegetables. Adult third parties may be present on farms for a similar range of reasons. Because the third parties are such a diverse group it would not be possible to calculate, or even to estimate, the size of the population at risk from agricultural activities. It is likely however that the numbers of children resident on farms has declined in recent years because of the trend towards a smaller number of larger farms. In addition the average age of farmers is increasing, as younger people find it more difficult to enter the industry because of its high capital requirement. It is however known that in the late 70's and early 80's, approximately two thirds of child fatalities involved children normally resident on the farm (Whittaker, 1985).

1.5 The future

In 1992 the Government published the 'Health of the Nation' White Paper (Department of Health, 1992) in which was outlined a strategic approach to health issues affecting the population of England. A number of key areas were targeted for improvement, one of which was accidents.

Specific targets were set for the reduction of accidents to people in certain age groups, by the year 2005. The death rate for accidents to children aged under 15, was to be reduced by 33%, to young people aged 15-24 by at least 25%, and to people aged 65 and over by 33%. As has already been seen, the victims of agricultural accidents frequently come from these age groups. (Department of Health, 1993)

1.6 Summary

In recent years the agricultural industry has been going through a period of massive change, moving from the 'dig for victory' situation of the war years to the food surpluses of the 1990s. Productivity has increased but at the same time the size of the agricultural workforce has declined to less than half its level of the 1960s, and there have been changes in the mix of groups making up the population at risk of farm accidents.

The self-employed now make up a relatively greater proportion of the population who are active on farms. Unfortunately they are a group afforded little protection by the prescriptive agricultural Regulations introduced in the 1960s. The increase in leisure time means that more people are visiting farms, and the need to 'set aside' land for non-agricultural use has resulted in farmers actively seeking and developing new enterprises, leading to further changes in the population at risk.

The number of people killed in accidents on farms has declined considerably since the 1960s but the concurrent decline in the population working on farms, has resulted in there being little improvement in fatal injury incidence rates. The fatal injury incidence rates for agricultural occupations are similar to or higher than those found in the Construction industry, about 4 to 5 times the rate in General Manufacturing, and some 10 to 15 times the rate found in the Services sector of the British economy. The fatal injury incidence rate for employees in the agricultural industry is declining at a similar rate to that in the construction industry. However, over the past 15 years, there seems to have been no improvement in the injury incidence rate for the self-employed within the agricultural industry.

Chapter 2. Review of agricultural accident research literature

2.0 Objectives

An examination of publications and statistics together with a review of research literature was carried out in order to explore the following questions:

(a) what is the population at risk of accidents, and what are the vulnerable groups;

(b) how diverse is the agricultural industry and its workforce and how does this differ from other industries;

(c) how dangerous is the industry relative to other countries, other industries within Great Britain, and what are the trends;

(d) what shortcomings of the regulatory control regime can be identified and what is the cost of accidents;

(e) what insights can the literature bring to specific categories of accident, and the success or otherwise of education and training initiatives;

(f) what are the strengths and limitations of published research in the context of this study;

2.1 Introduction

Previous research into agricultural accidents has tended to seek to establish the absolute level of accidents, or to try to identify particular groups of persons sharing one or more characteristic, who have had an accident in defined circumstances. Identified groups have often included children and old people, and those using certain items of equipment.

Sometimes parallels are drawn between accidents on farms and those that happen in other industries. Often however on farms the sorts of accidents that happen are the same as those that occur in non-work situations. When seeking to gain insights into some types of farm accidents it is sometimes appropriate to look for parallels in home, leisure or road traffic accident research, rather than in research into industrial accidents. Examples would include slips, trips and falls at ground level, and transport accidents which may be identical to road traffic accidents, except that they happened on a farm track rather than on an adopted road. These parallels arise because the farm is often not just the workplace, but the home, and the playground of those living there.

In the 1960s Knapp (Knapp 1966) produced the following table highlighting the differences between agricultural workers and those employed in other industries.

Although working in the United States over thirty years ago most of the differences identified by Knapp hold true for modern British farming. There are however some differences. Agriculture in Great Britain is not specifically excluded from government inspection as it was in the United States. Training in agricultural work has become better and more comprehensive because of the efforts of the National and County Agricultural Colleges and the Agricultural Training Board (ATB), now ATB Landbase. One other difference not noted by Knapp is that in industry the Company usually pays for Health and Safety improvements, whereas on farms the farmer pays, an important consideration in bad years, or on marginal farms.

Conversely changes in the structure of the industry and in the public's perception of land use have led to an increase in the size and changes in the makeup of the population at risk, with more people visiting farms as a leisure activity.

Category	Industry (Individual Plant)	Farm (Family)
Place of work	Separate from home	Identical with home
	Separate labour and management	Combined labour and management
Workforce	Concentrated, easily checked	Diffuse, difficult to service, usually specifically excluded from check by labour and health departments.
	Limited to adults	Includes young and old
Work routine	40-hour work week	No limit on work, daily or weekly
	Instructed in details of work	Self-taught, trial and error
	High degree of routine	Tempo highly erratic
	Maintenance work by experts	Jack-of-all-trades
Health requirements	Medically selected (preplacement)	No minimum physical level
	Periodic physical examination	No routine medical surveillance

	Hygiene facilities provided and accessible	Individual variation depending upon personal habits
	Transfer for medical reason possible	Change difficult
	Health insurance common	Less common
	Vacations usual	Vacations erratic
Emergency medical services	Available	Removed from work
	Warning devices available	No alarms, showers, eye fountains in the 'back forty'
	Workers near to assist, warn, call for help	Usually works alone
	Rehabilitation emphasised and available	Not emphasised or readily available

Table 2.1 Differences between agricultural workers and the industrially employed.

(Source: Knapp 1966)

2.2 Agricultural accidents in Great Britain

Research into the causes and prevention of agricultural fatal accidents in Great Britain is sparse. Singleton (1970) drew attention to the rapid pace of change in the Agricultural Industry, arising from increased mechanisation over the previous thirty years. He pointed out that as the development of worker protection systems lagged behind technological advances, so farm workers were exposed to a greater range and intensity of hazards than their forebears and that they were probably 'in greater danger than almost any other worker'. He highlighted the difficulty in acquiring objective evidence of the increasing danger, and argues that 'the improvement of the lot of the farm worker requires extensive field and laboratory research'. Singleton also quoted a fatal injury incidence rate of 151 per 1,000,000 workers in the agricultural industry and contrasted it with the corresponding figure for (manufacturing) industry of 42 per 1,000,000 workers. (Ministry of Agriculture Fisheries and Food (1969), and Department of Employment and Productivity (1969))

Singleton, Ainsworth and Ströder (1984) used summaries prepared by the Agricultural Inspectorate to analyse the 1,200 fatal accidents reported between 1968 and 1982. Separate analyses of objective and subjective data items were carried out, together with an analysis designed to identify various 'Standard Accident' scenarios. The summaries were described as adequate for explaining the 'geographical and mechanical context of the accident'. The summaries were however, judged to be weak in the area of human factors, such as personal characteristics, details of the organisation of which the deceased was a part, and precise details of the working environment at the time of the accident. Singleton et al (1984) commented that they 'felt this database could yield further useful information, especially if some of the entries could be replaced with more detailed information from other sources'.

In 1986, HSE published 'Agricultural Black Spot - A study of fatal accidents' (Health and Safety Executive 1986a). This work was written by

David Butterworth in the Accident Prevention Advisory Unit (APAU), following a detailed analysis of the circumstances of 296 agricultural deaths which happened in the years 1981-84. It contained a general analysis of the accidents under the headings, 'Where', 'Who', 'When', and 'Why'. The accidents were split into 'Black spot' categories and described in greater detail. The categories were; 'Self propelled machines', 'Field machinery', 'Falls', 'Falling objects', 'Animals', 'Drowning/ asphyxiation', 'Electrical equipment', 'Stationary machinery', 'Powered hand tools', 'Diseases', and 'Accidents not elsewhere classified'. As with Singleton et al (1984) the work is strong on descriptions of the machinery and work involved, but lacks an analysis of the characteristics of the individuals, or of the organisations of which they were part, and of factors that might have prevented the accidents.

2.3 Agricultural accidents in Europe

Singleton (1984) in a paper on trends in accident research in European countries' notes that since 1970 there has been a large increase in accident studies. Much of the work has involved the collection and analysis of data from real situations, with the result that there had been a dearth of new theoretical concepts. Singleton highlights a shift in emphasis over the previous fifty years from trying to identify the 'accident prone' to the identification of situations in which accidents occur. Safety research has, Singleton argues, too closely followed the standard methodology of the physical sciences, in which observations are analysed, then theories generated and used to make predictions that are tested in controlled situations. Accidents are multi- rather than uni-causal which makes meaningful prediction almost impossible. In any case, ethical considerations preclude the testing of accident causation theories in controlled situations.

Singleton compares the accident researcher with a doctor treating an unknown disease. The patient's lot can be eased by treating the symptoms in such a way as to ensure that the body's normal operating parameters (e.g. of temperature, blood pressure, pulse rate) are not exceeded, without the physician being able to identify precisely what the disease is, nor what caused it. Singleton argues that 'the safety specialist might be more effective if he were to concentrate rather less on looking for theories which will explain the cause of particular accidents and devote his attention to identification of the key parameters which can alter the probability of accidents generally'. It can even be argued that this is the best that he will ever be able to do.'

Singleton, Hicks and Hirsch (1981) carried out EC-sponsored research into 'Safety in agriculture and related industries' in the EEC and other European countries. The report contained a brief review of agricultural accident statistics for a number of European countries. There was also a more detailed survey, based upon data from England, Scotland, and Wales, primarily for the period 1976-1980. The report concluded, that '...the rural industries are more dangerous, as measured by fatal accident rates, than almost all other forms of employment', and that, although the number of accidents had declined, the fall in accident rates had been less marked. They attributed the decline in accident numbers (and rates) to the engineering approach of national legislation combined with enforcement by peripatetic inspectors paying particular attention to physical issues such as guarding. Singleton et al (1981) concluded that 'It would now be appropriate to introduce a more behavioural approach to safety to complement the engineering approach'. Such an approach would seek to instil in persons at work on farms a 'greater personal awareness of hazards and their avoidance'. They also concluded that the agricultural accident statistics available were barely adequate to identify national trends, and incapable of being used to compare countries.

2.4 Agricultural accidents in the Americas

Moretz (1989) reported on agricultural injuries in the United States. He quotes National Safety Council estimates of 1,500 deaths, and 140,000 disabling agricultural related incidents in 1988. With a death rate of 48 per 100,000 workers (more than 5 times the national average) this makes agriculture the United States' most hazardous industry. Agriculture became the 'most hazardous industry' in 1980 since when fatal injury incidence rates have remained fairly constant whilst rates for other industries have declined.

Recent figures from the United States (Bureau of Labor Statistics, 1994) confirm that agriculture continues to have the highest fatal injury incidence rate of any industry in that Country. The figures record a fall in the rate for 1993, to 26.95 per 100,000 employees that is only marginally more than the 26.01 rate for Mining. The rate for Agriculture is still however almost double the 13.74 of the Construction Industry, and more than 7 times higher than the 3.92 rate for Manufacturing Industry.

The reason most usually quoted for the high fatal injury incidence rates experienced by the agricultural industry in the United States is the 'small-farm exemption'. Whilst the Occupational Safety and Health Administration (OSHA) is charged with protecting the safety and health of all workers, in the case of farms it is constrained by this 'small-farm exemption'. The exemption was introduced in 1976 and prevents OSHA from doing anything on farms that employ 10 or fewer workers. Approximately 96% of all US. farms fall within this classification.

Moretz (1989) highlights the disparity between the amounts of Federal money spent on the promotion of safety within different industries. He quotes figures of 30 cents each per year for farmers, and $180 per year for each miner. Whilst some States have full-time agricultural safety professionals others employ a specialist for half or a quarter of their time.

These professionals are funded partly by the US. Department of Agriculture, and partly by top-up funds from individual States.

Kraus (1985) carried out a literature review of work related fatal and non-fatal accidents in the United States. He noted an improvement in the uniformity of collection of data over the previous 10 to 15 years. Kraus also commented that the number of work-related fatalities in the US was unknown. This was because of variations in the definition of what constituted a work-related fatality and differences in the collection systems of the agencies involved in collecting the data.

Myers (1990) reported on gaps in existing surveillance systems for occupational injuries in the United States, and concluded that 'The agricultural industry is the least adequately covered of all'. To improve coverage, the National Institute of Occupational Safety and Health (NIOSH), Division of Safety Research created the National Traumatic Occupational Fatalities (NTOF) database. The database uses data from death certificates, where the cause of death was 'external', the victim was at least 16 years old, and the injury was sustained 'at work'. The 1980-85 data on the NTOF database showed that 'agriculture had a work related fatality rate of 20.7 deaths per 100,000 workers compared with 7.9 deaths per 100,000 for the private sector US. workforce.' Myers concluded that 'Agriculture is one of the most hazardous industries in the United States'.

The fatal injury incidence rate for 1980-85, of 20.7 deaths per 100,000 calculated from the NTOF database (Myers 1990) is lower than both the 1988 figure quoted by Moretz (Moretz 1989), of 48 deaths per 100,000, and the more recent Bureau of Labor (Bureau of Labor Statistics, 1994) figure of 26.95. These wide variations appear to arise from differences in the databases used to make the calculations.

Murphy, Seltzer, and Yesalis (1990) quote National Safety Council (NSC) figures for fatalities in the agricultural industry of 46 per 100,000 workers, and National Institute of Occupational Safety and Health (NIOSH) figures of 18.36, for the same year, 1984. To try and explain these discrepancies, they followed up all the agricultural occupational fatalities that happened in Pennsylvania during the years 1985-87. They found errors of almost 30% in the NTOF methodology used by NIOSH, which they calculated would lead to a 20% undercount in agricultural fatalities. They concluded that the reasons for the differences arose from (a) incomplete or inaccurate information on death certificates, (b) exclusion of certain categories of accident, e.g. where the victim was under 16, and (c) the accident arose whilst the victim was not engaged in their primary occupation. In the NTOF system the death certificates are coded for the 'usual industry' of the victim, and this is taken as a proxy for the industry in which the victim was engaged at the time of the accident.

Despite these definitional problems which lead to variations in US. fatal injury incidence rates of between 18 and 48 per 100,000 agricultural workers it is obvious that US. rates are much higher than those in Great Britain, which are, as has been discussed in Chapter 1, about 8 per 100,000. The reasons for the discrepancy in the US. fatal injury incidence rates appear to include the enforcement regime with its 'small farm exemption', and that country's failure to make the fitting of Roll Over Protective Structures (ROPS) mandatory. (See section 2.8)

Hoskin and Miller (1979) conducted a 21 state farm accident survey covering 24,703 farms. Smaller farms were under represented in the study, to such an extent that the distribution by size of farm was significantly different to that found in the 1974 US Census of Agriculture. Whilst not reflecting the national picture, the results were considered to be useful in identifying accident problems.

The study found in the case of females, both family and hired workers, that accident frequency correlated with exposure to farm work rather than to age. However females aged 15 to 24 experienced a third fewer accidents than predicted, whilst those in the 45 to 64 age group had about 20% more than expected.

In the case of males the study recorded that the distribution of injuries by employment status and by age was significantly different to what was expected, based upon exposure. Male family members in the 5 to 24 age range experienced more injuries than expected, and those older than 44 also suffered more. For hired males, those aged 15 to 24 were over-represented, whilst the 25 to 64 age group was under-represented. It was thought that the differences could be accounted for by variations in the assignment of hazardous tasks, and in the levels of safety awareness, experience, and maturity of those involved.

Howell and Smith (1973) reported on an epidemiological study of agricultural accidents in a mixed farming area of Alberta in 1970. Among their observations was the comment that 'Mechanical failure sometimes proved to be the result of operator failure, as in neglect of routine maintenance; and the person to whom the failure was attributed was not always the person injured.' They also commented on the need to '...develop criteria by which characteristics of the operator, circumstances of the accident, and design features of the equipment which have led to or permitted operator failure, can be described.'

Huston and Smith (1969) examined reports of 247 farm fatal accidents in the predominantly agricultural province of Saskatchewan in Canada that happened between 1955 and 1967. They noted that 28% of the fatalities happened to children or adolescents, and that 23% happened to men over 60, the oldest person killed being 88. Unusually Huston and Smith drew attention to the problem of concurrent medical problems suffered by those involved in the fatal accidents. They identified 29 individuals with medical problems and concluded that in only 6 cases was it possible to say that the medical condition did not contribute to the accident. They put forward a tentative conclusion that '...the information available suggests that disorders likely to reduce alertness, produce transient impairment of consciousness or impair mobility are likely to increase the dangers of working with farm machinery, particularly for older men.'

Huston and Smith appear to have looked only at concurrent medical conditions that may have increased the likelihood of that individual, having that accident, at that time. They made no comment about any concurrent medical conditions that, having had the accident, may have increased the probability of that person succumbing to their injuries.

Knapp (1966) commented that 'The farmer is not necessarily a healthy person, in the sense that living on a farm makes a person healthy. Rather, the farmer must be a basically healthy person if he is to live on a farm. The problems of working in the heat and cold, dust and fumes, rain and sun, in spite of colds, asthma, allergies, bruises, and zoonotic diseases, makes farming a struggle for physical self preservation.'

Research carried out at Purdue University, Indiana, in the 1980s (Field and Tormoehlen (1985), and Tormoehlen and Field (1983)) highlighted some of the handicaps suffered by farmers which in addition to those arising from accidents include cardiovascular diseases and disorders, dust and mould allergies, back and spinal problems, and arthritis and other disorders. The research sought to identify the extra risks to those who continue at work despite suffering a physical impairment. Examples cited included the added risk involved when attempting to use a manlift to evacuate a tractor or combine that was on fire, and the added risk to others arising from the farmers disability.

Simpson (1984) carried out an epidemiological study of all of the farm machinery injury cases hospitalised in 1980 in the three hospitals in Saskatoon, the second largest town in Saskatchewan, Western Canada. The 48 cases studied represented the most severe non-fatal injuries that happened within a 100 mile radius of Saskatoon in 1980. In addition there were 11 fatal agricultural accidents in Saskatchewan in the same year, and an unknown number of patients suffering minor injuries who were treated by local physicians. She found that in agriculture the work injury death rate is much higher than in other major industries; that farm machinery was involved in approximately half of accidents reported; and that non-fatal injuries arising from power take-offs and augers were particularly severe and disabling. Simpson thought it likely that four of the eight farm machinery deaths in Saskatchewan in 1980 would have been prevented if the tractors involved had been fitted with ROPS.

2.5 Agricultural accidents in the rest of the World

Steele (1993) reviewed New Zealand's recent agricultural fatal and non-fatal accident history and compared it with the performance of other countries. He analysed 234 fatalities, and 4875 severe non-fatal accidents using data from the Accident and Rehabilitation and Compensation Insurance Corporation. He identified general and livestock farmers, and farm workers together with shearers and female stable hands as high risk groups. He concluded that tractors, All Terrain Vehicles (ATV's) and firearms were more commonly associated with fatalities. He reported that between 1975 and 1984, 1 farmer in 5,200, and 1 worker in 1,800, was killed in agricultural accidents each year. This equates to fatal injury incidence rates per 100,000 at risk, of 19.2 for farmers, and 54 for workers. Interestingly the rate for workers is higher than for farmers, which is the opposite to the situation in GB. In addition the farmer's rate is almost double the current level in GB. This apparent anomaly is not commented upon by Steele. It may simply be a function of the legislative regime or related to the more pastoral nature of farming in New Zealand, or reflect the extent to which farmers participate in the more hazardous tasks.

2.6 Age in relation to accidents

Children

Chapman and Spinks (1994) surveyed 245 children aged 10 to 14 who were resident on farms in Australia. The study sought to identify those activities that children took part in on farms, to identify what children considered the greatest hazards, and to gain an insight into their ability to identify farm hazards. They noted that in Australia 'Farming accounts for the most work related deaths of children under the age of 15 years and results in rural children having a higher incidence of work related injuries than urban children.'

The study found that 98% of the children took part in farming activities and that those activities included the main tasks associated with the death and injury of children on farms. Chapman and Spinks also found that whilst children did not consider driving (e.g. a tractor, or motorbike) to be a hazardous activity, they did consider riding on the back of a tractor, truck or motorbike to be hazardous. Chapman and Spinks were also able to identify the development by children of what they referred to as 'a conditional perception of a hazard'. They found situations in which children did not recognise a situation as inherently dangerous, but only dangerous when some other condition was also present. Examples quoted included motorbike and horse riding where the situation was only perceived as hazardous when a further condition such as 'going too fast', or 'not wearing a helmet' was present.

Chapman and Spinks concluded that whilst children (in the 10-14 age group) do have a reasonable awareness of farm hazards, their knowledge does not get translated into safer behaviour.

Older Workers

King (1950) carried out a study of 1,991 accidents to agricultural workers that resulted in medical treatment. He found that the causes and kinds of accidents varied with age, as did the nature of injury, and the part of body that was affected. The kinds of accident that were found to increase with age were falls (from heights, and at ground level), and being hit by falling or moving objects. Accidents whose frequency was found to decrease with age included those involving machinery and handtools, those arising from continued activity (repetitive tasks), and starting engines. Findings in relation to the part of the body injured were, of increases in the frequency of injuries to the trunk, skeleton and muscles, and to a lesser extent, the legs. The frequency of arm injuries decreased with age.

King concludes that practical measures to prevent accidents must take into account the fact that the causes, nature and parts of body injured in accidents vary with age.

Haigh and Haslegrave (1991) carried out an HSE sponsored literature review of ageing in relation to occupational health, safety and performance. They pointed out that whilst ageing is continuous throughout adult life, the age of onset and rate of decline of different physical and cognitive abilities varies widely between individuals. They found that the consequences for health and safety of the ageing process can only be assessed in relation to the tasks actually performed, and the physical and organisational environment in which they are undertaken. The tasks and the environment in which they are carried out appear to influence the workers health and safety just as much as ageing does. Haigh and Haslegrave concluded that there were 'few conflicts between the needs of younger and older workers and that such improvements would benefit both.'

2.7 The costs of agricultural accidents

Monk, Morgan, Morris and Radley (1984) reported the findings of a 1981-82 study into 'The Costs of Farm Accidents'. The research, sponsored by HSE sought to supplement existing information on fatal and reported non-fatal farm injuries with data on unreported, and often non-injury accidents that happened on British farms over a one year period. The study sought to establish the costs to employers, employees, and the British economy, of accidents in the agricultural industry.

Monk et al defined an accident as an incident that resulted in an injury to a person causing at least half a days' absence, and/or damage to property. They estimated that there were about 85,000 accidents each year on British farms, that the total resource cost to the British economy was £94 million, and that the total financial cost to farmers was £62 million.

In the early 1990s studies (Health and Safety Executive, 1993) carried out in HSE's Accident Prevention Advisory Unit by the author and others sought to assess the cost of accidents to organisations working in different sectors of the British economy. The studies identified losses of 37% of annualised profits in a transport company, 8.5% of the tender price for the building of a Supermarket, and 14% of the potential output of an oil production platform.

Recently HSE's economists have extended these results to the agricultural industry (Davies and Teasdale, 1994). They concluded that each year there are over 38,000 accidents involving injury or death, and that the cost to the victims and their families is at least £120 million. An average fatality will cost a family around £575,000, and an injury resulting in early retirement would cause losses of around £140,000.

2.8 Specific classes of accidents

Some research has been carried out into specific types of agricultural accidents. The largest body of this research relates to the prevention of injuries when tractors overturn by the provision of safety cabs (Roll Over Protective Structures), but there has also been much research done, particularly in the Scandinavian Countries, on accidents arising during tree felling.

Animal accidents

Of the 2,760 occupational injuries identified by Hoskin and Miller (1979), 414 (18%) were found to be animal-related and were investigated in greater depth. It was found, when compared with all the injuries recorded, that animal injuries occurred significantly more frequently in the categories, 'caught between', 'caught under', and 'struck by or against', the agency of injury.

Eighty percent of the victims were male, almost a third were aged 25 - 44, over a quarter 45 - 64, and a fifth were aged 15 - 24. The most common injuries were bruises and fractures, and a significant proportion (over 35%) were found to have had less than one day's experience with the animal. Conversely 28% had more than 6 months experience with the animal that injured them, suggesting that the injured person was very familiar with it and may have been lulled into a false sense of security by its previous docility.

Fifty-seven percent of the cases involved cattle, 27% horses, 5% hogs, with the remainder a mixture of dogs, cats, chicken, sheep and others. Cows were involved in 74% of the cattle related injuries. Those that occurred during milking were found to be particularly costly in terms of days absence, and the financial costs of replacement labour. In the non-milking category protection of young was recorded as a significantly frequent circumstance in which injury occurred.

Injuries arising from accidents involving horses were found to be more frequently associated with leisure time, and to involve 5 - 14 year old daughters with limited experience with horses.

Hoskin and Miller argue that greater emphasis needs to be placed on the modification of both the working environment and human behaviour in relation to animals, since little can be done to change the animals behaviour. Whilst some slight improvements may be made by selective breeding for docility, animals will always be inherently dangerous simply because of their size and unpredictability. However docile a bull is, it will still weigh over a tonne, and woe betide the stockman who approaches, if it has been stung by a wasp. Hoskin and Miller recommend greater caution when approaching animals, and that more attention be paid to the proper securing of animals.

Overturning tractors

Moretz (1989) commenting on agriculture in the United States, noted that 'While many newer tractors come with roll-over protection structures (ROPS), many older tractors that don't have protective structures are still in use.' He also refers to a Pennsylvania State University study (Huizinga and Murphy 1989) which reported that only 19% of tractors in use on farms in Pennsylvania were fitted with ROPS, and that the average age of tractors was 21 years.

Kelsey and Jenkins (1991) confirmed the consistently high fatal accident record of agriculture in the United States. They point out that tractors were involved in about 50% of agricultural fatalities with roll-overs occurring in about half the cases, and that ROPS are not currently mandatory in the United States. They examined the cost of the implementation, in New York State, of a proposal to retrofit ROPS. The policy would require ROPS on all tractors after 10 years, with an offer to farmers of retrofit incentives during the first 5 years. They concluded that the total cost would be $36.3 million for a saving of 53 or 71 lives, depending upon how effective ROPS are at saving life. The minimum economic cost was calculated at $511,136 per life saved which was similar to the cost of other life saving interventions.

As long ago as the late 1970s researchers (Karlsen and Noren, 1979) were drawing attention to the high rate of tractor associated fatal injuries on farms. They recorded a death rate from tractor related accidents among male Wisconsin farm residents, of 10.9 per 100,000, in 1961-65, rising to 13.6 per 100,000 in 1971-75. About 50% of the deaths involved overturning tractors, illustrating that voluntary safety standards were not effective in preventing deaths. Karlsen and Noren recommended that all new tractors should be equipped with ROPS, as 'is currently the case in England [sic] and Sweden.' In addition to the high fatal injury incidence rates, they cited accidents to males under 19, and accidents to the over 60s on farms, as reasons for providing automatic protective devices that cannot be circumvented.

Tree felling

Much research on accidents involving forestry work has been carried out in Scandinavia. Klen and Väyrynen (1985) reported on research in which they sought to assess the reliability of the statistical system used in Finland for accident recording, by examining the difference between research and statistical data. They also sought to establish whether the accident antecedents of near accidents were similar to those for accidents resulting in injury. The researchers sent a questionnaire to 1,194 loggers at the beginning of 1980 in which they enquired about 'accidents resulting in injury, and near accidents in which some protection or safety device prevented injury, over a period covering the last 12 months.' The frequency of accidents and the severity, and distribution of injuries among the 1,089 respondents were found to accord well with national statistics. It was concluded that whilst there were some measurable differences between injury accidents, and near miss accidents, the analysis of near miss accidents can with care be used to predict accidents. The relationship between injury accidents, and near miss accidents was more predictable in cases involving injury (or near injury) by a chainsaw. The differences were also affected by whether protective devices had operated or clothing was used. This tends to support the argument that behaviour when protective devices are in use is different to behaviour when such devices are not available.

Östberg (1980) carried out a study in Sweden designed to test the hypothesis that tree fellers had a sound knowledge of which working methods were dangerous and which were safe. The study was prompted by statistics which revealed that whilst safety interventions had successfully reduced the number of accidents in the jobs following felling, i.e. snedding, cutting, forwarding and transporting, the number of felling accidents had remained unaffected. Östberg administered a questionnaire to 731 subjects from 6 different groups of forestry personnel in which they were asked to assess the risks involved in a number of pictured forestry situations. The results confirmed 'that the fellers had an accurate and consistent knowledge about the risks in typical felling situations.' The more experienced workers were judged to be better at assessing the relative risks of different situations, but tended to underestimate the absolute level of risk. Supervisors were found to be the group which most underestimated the risks, highlighting the need for closer collaboration between the production and safety systems.

Östberg concluded that there was little scope for reducing accident rates by further training designed to change fellers behaviour. Any reduction in accident rates would have to be achieved through the introduction of production methods and work organisations supportive of safe behaviour.

Some of Östberg's findings particularly in relation to violations are of interest. He found that two thirds of the workers sometimes used forbidden methods, which they did not consider involved extra risk; forbidden methods were used to increase earnings from piecework, to save energy, or because there was no other practicable method; those who had suffered recent accidents had different opinions about work techniques, than those who had not been injured; supervisors in small companies are more lenient in safety matters; older workers earn less and are less willing to compromise on safety; safety minded workers have safety minded supervisors and; piecework promotes irregular work pace and hence unsafe working behaviour.

Drowning in grain

A fact sheet issued by the Farm Safety Association Inc. of Ontario (Farm Safety Association Inc. 1985) reporting on entrapments in flowing grain makes the point that 'most victims of this type of accident are under 16 years of age'.

Falls

Whiting (1975) in describing the agricultural accident situation in California mentioned a reduction of 40% in injuries arising from falls from height, between 1965 and 1970. The reduction was particularly noticeable in those parts of the state where lemons were grown. Changes in husbandry techniques meant that trees were trimmed to a height that made ladders unnecessary for subsequent care and harvesting.

Similar reductions in the number of ladder related accidents have probably happened in this country particularly in the case of apple orchards. Apart from the reduction in the population at risk arising from the decline in the acreage grown following the widespread grubbing up of old orchards in the 1960s and increased mechanisation of the crop, the introduction of newer dwarfing rootstocks has reduced the need for ladder work in our orchards.

2.9 Education and training

A joint World Health Organisation, Scottish Health Education Group workshop on education for safety was held in Edinburgh in March 1984 (World Health Organisation 1986). The workshop brought together experts from the fields of road, home, fire and sports and leisure safety, to consider the existing safety education policies and practices in Europe, and to '....make proposals on the content of, and methods used to implement comprehensive safety education programmes at the local and national levels....'. Whilst the workshop did not include experts in occupational accidents, there are many parallels. This is particularly true in the case of agricultural accidents, many of which involve children, perhaps living on farms, and possibly injured in transport, fire or leisure type accidents, i.e. the distinction between road (transport), home, fire and sports accidents is blurred in the case of children's accidents on farms. Indeed the final recommendation of the report acknowledges that 'The principles expressed here are also applicable to the field of occupational safety'

Amongst the other recommendations were a number that are of direct relevance to this research. For example they recommended that 'In-depth studies of all the circumstances surrounding accidents should be carried out.' The studies should include data on all the persons and products involved, and be 'supplemented by population-based surveys to ascertain normal patterns of behaviour and potential risk factors.'

The workshop also recommended that 'those involved in the implementation of safety programmes should have some training in epidemiological methods' and highlighted the 'urgent need for health personnel to understand the need for adequate data collection.' Collectors of data would thereby become motivated by a knowledge of the need for and use of the data they collected.

In the United States, Reisenberg and Bear (1980) undertook a study to examine the educational backgrounds of members of farm households, and the contribution of the various age groups to the amount of work done on farms. The study formed part of the 1978 Minnesota Farm Accident Survey and involved a stratified random sample of 1,910 farms in 20 of the States counties.

They found that the existing education programmes were not very effective in reaching the under 15 age group, a group that suffered many more accidents than predicted. They also found that there was a difference in the participation in agricultural vocational education between those involved, and those not involved in accidents. However the difference was in the 'wrong' direction. Those who had received some agricultural education were more likely to be involved in an accident. The reason for this may have arisen from the content of the training together with a false assumption that 'safety training was given a high priority'.

Steele (1993) discusses the system used in New Zealand in the 1970s and 80s where the Accident Rehabilitation and Compensation Insurance Corporation (ACC) employed 7 rural safety officers who worked with women's groups and Young Farmers Clubs, to promote farm safety. They produced safety booklets, videos and leaflets, and carried out education programmes. In 1984 the ACC produced a manual and video on sheep and cattle handling in New Zealand conditions (R. J. Holmes. Sheep and cattle handling skills - A manual for New Zealand conditions, ACC, 1984) which was widely distributed. Unfortunately there was '..no systematic follow-up or evaluation to test its impact on injury incidence or severity.'

Phillips, Stukey and Pugh (1975) studied accidents involving farm families in the State of Ohio. They compared those that happened in 1967 with those in 1972. For the purposes of the study an accident was defined as an event that resulted in an injury requiring professional medical attention or causing the loss of at least a half a day's work. Phillips et al found that the number of 'on-the-job' accidents per 1,000 farm persons was lower in 1972 than in 1967, and that significantly more accidents occurred on larger farms (200 acres or more) than on smaller farms, in both years studied.

Phillips et al also found that the higher the educational attainment level of the head of the household the more accidents the family was likely to have. This surprising result was consistent with earlier studies, and was thought to arise because 'more educated farmers operate more acres, utilize more machinery, work longer hours, and are generally exposed to more and higher risk situations.' In their discussion of previous work in this area Phillips et al referred to work by Stout and Darbee (1972) who studied sixty farm accidents and found 'conscious risk acceptance, hurry to meet deadlines, and mental distractions as the major cause of injury [sic].'

Erisman and Huffman (1972) collected data on the accident history of 2,547 male farm operators in 11 Counties in Illinois, and at the same time administered a 'Revised Huffman Inventory' (RHI) questionnaire.

The RHI produces a single index of emotional maturity and is based upon indices of 'impulsiveness, exhibitionism, carelessness, aggressiveness, intolerance, philosophy of life, resentfulness of authority, social adaptability, low morals, economic independence, egocentricity, indecision, inconsiderateness, distractibility, and guilt feelings.' They found that operators of large farms had lower measured levels of emotional maturity, and a greater accident frequency than operators of smaller farms. They also noted that lower emotional maturity and greater accident involvement was exhibited by farmers in the younger age groups, 15-24 and 25-44. They did however find no significant relationship between types of accident and emotional maturity.

Their findings strongly support the view expounded by Roy (1957) that '....there are two main sources of variation related to farm accidents - the farm and the people living on the farm.' As Erisman and Huffman (1972) put it the 'Interaction of exposure to hazards and individual accident susceptibility appeared to be a critical component in farm accident causation.'

The finding of Phillips et al (1975), Stout and Darbee (1972), and Erisman and Huffman (1972) are consistent with the view that self-employed farmers are more likely to be involved in accidents arising from inappropriate risk taking (violations) than are their employed counterparts.

2.10 Alcohol

In a study of 148 work related fatal injuries in Maryland in 1978, Baker (Baker 1982) found that in 11% of cases the victims had blood alcohol concentrations of 0.08% by weight, or greater. Only twelve of those killed worked in agriculture, but many with high blood alcohol levels were involved in transport accidents, both on and off road.

Baker points out that data of potential use in the understanding of work related injuries, and in the development of preventive strategies is often not collected. She cites as an example the failure to routinely record details of the make and model of tractors, forklifts and cranes involved in crashes when the usefulness of such data has been demonstrated in the case of road vehicles. Baker also makes the point that many of those killed are in high-risk groups of workers excluded from the protection offered by the health and safety legislation. Particular groups cited include people who drive as part of their jobs, those at especial risk of violence, and farmers.

2.11 Summary

The study of publications and research literature reveals the following points:

(i) The wider population at risk.

Whilst there are some similarities between agriculture and other industries, there are also a number of distinctive features of farming which give rise to differences in the population at risk, and in the hazards which that population faces. Often the working farm will also be the home of the farmer and his family, tied cottages house current or retired workers, holiday cottages contain a shifting population of agriculturally naive visitors, and houses sold off will swell the population of villages and hamlets. Each of these factors will tend to increase the size and diversity of the population at risk compared with that found in factories and mines. The population at risk of agricultural accidents thus comprises of the complete age range, which when combined with the wide range of knowledge and experience encountered means that measures to prevent accidents are difficult to target.

(ii) Vulnerable groups.

The wide range of persons at risk in agricultural leads to a number of accidents where a characteristic of the victim either increases the likelihood of that particular person having that particular accident or alternatively heightens the possibility of them succumbing to their injuries. One example of this is the number of elderly victims recorded in the statistics. Older slower less agile people at work on farms are hurt by animals, or slip and having failed to recover their balance, are injured. Field and Tormoehlen (1985) highlighted some of the health and safety issues which can impair the faculties of those at work in agriculture. Their work has even resulted in the publication of 'Breaking New Ground', a newsletter for farmers with physical disabilities, and in the preparation of a number of pamphlets directed at farmers with specific disabilities who still wish (or need) to actively participate in farm work.

Children are another obvious example where the characteristics of the victim lead to a greater propensity to have an accident. Research in Australia (Chapman and Spinks 1994) suggested that children have a two stage perception of danger in which a dangerous activity is not perceived as dangerous unless there is another factor present. The population studied in that Australian research comprised children normally resident on the farm who habitually took part in farming work. In Great Britain the child victims of agricultural accidents are often not resident visitors to farms so their knowledge and perceptions of agricultural hazards could be expected to be different to those of agriculturally aware Australian farm children.

(iii) Diversity within the industry.

Throughout this work reference has been made to Agriculture as though it were a single industry. In fact agriculture is not one industry but several. Livestock (dairy, beef, sheep, pigs, deer, fish and poultry) and arable farming, estate and commercial forestry, amenity horticulture, and field vegetables are all part of the agricultural industry with each crop or enterprise having its own particular hazards and risks.

(iv) The agricultural workforce.

The characteristics of the agricultural workforce are different to those of people engaged in factory work. Knapp (1966) working in the US. identified a number of differences between agricultural workers and those employed in other industries. All of those differences are still relevant to agriculture in GB. together with a number of other differences which can be identified. The workforce on farms is generally small leading to less specialisation in tasks performed. The farmer not only manages the work, but often does a large proportion of it himself. The stockman has also to be tractor driver and machine operator. Tractor and machine operators will carry out routine maintenance and even emergency repairs, in situations where specialist assistance is not readily and speedily available.

The size of the workforce is generally small, so there is a greater likelihood of individuals working alone which means that supervision is more difficult and persons suffering injury do not have ready access to assistance. Unlike factories most of the machines found on farms need to move across the ground to operate leading to an increased risk of vehicle accidents.

(v) Shift duration and the acquisition of experience.

The nature of the work tends to lead to wide variations in the duration of shifts. Busy period such as lambing or harvest may lead to very long hours, although such times will be interspersed with relatively slack periods. Often the timing of particular tasks and their duration will be determined by the weather, by the perishability of the crop, or by market conditions. The seasonal nature of some tasks means that experience is often only slowly acquired. For example someone who has worked on a farm for 5 years may have a total of only 6 months experience of cereal harvesting as the work lasts for such a short time each year. Thus workers go from one job in which they are relatively inexperienced to the next in which they are also inexperienced. Contrast this with the situation in factories where one person may be working continually on the same machine, albeit doing variations on the same basic task.

(vi) Recent accident history.

Since the end of the Second World War the agricultural industry in Great Britain has undergone a period of rapid change one characteristic of which was a rapid increase in mechanisation. This in turn has led to a rise in machinery related accidents, the most obvious and well documented manifestation being the increase in fatalities arising from overturning tractors. This rise in machinery accidents has been documented in many hardware related studies reported in the literature.

More recently there has been a welcome decline in the total numbers of agricultural fatalities, as many of the main causes of machinery related accidents have been identified and solved. As a consequence there are now few hardware issues remaining to be addressed which have the potential to further reduce the number of fatalities, and it is necessary to examine the human factors involved in order to identify more key parameters to address in accident prevention programmes. The present work provides one framework which can be used to define and categorise such key parameters.

The absolute numbers of those killed in agricultural accidents has been declining steadily for many years. From the peak of 144 recorded in 1971, the absolute number of fatalities has fallen to the current level of under 60 a year. As previously noted this fall has been accompanied by a similar decline in the size of the agricultural population at risk. It appears that there has been little improvement in the fatal accident rate when the decline in the population at risk is taken into account. Latest indications are that there has been a recent steep rise in the absolute numbers killed in the industry.

Changes in the makeup of the workforce mean that there are now fewer full time workers and more part timers. The net effect of this will have been to reduce the total hours worked by those in the industry. It is not possible to quantify this reduction, but if risk factors had stayed constant this shift to part time working should itself have led to a further decline in fatal accident rates. This has not happened. Fatal accident rates in agriculture are consistently higher than for most other sectors of British industry and the rate for self employed farmers is even higher than that for construction workers.

(vii) Regulatory control of agricultural health and safety.

The health and safety of those at work in factories in this Country has been the subject of legislation since 1802 and in mines since 1842. However a comprehensive regulatory regime covering health and safety in the agricultural industry was not introduced until the late 1950's following the passing of the Agriculture (Safety, Health and Welfare Provisions) Act (Ministry of Agriculture Fisheries and Food 1956). This Act granted enabling powers to Ministers to introduce Regulations on specific subjects.

Before the introduction of the 'Notification of Accidents and Dangerous Occurrences Regulations 1981' (NADOR) there was no requirement on the agricultural industry to notify MAFF or HSE of injuries arising out of work-related accidents. Accidents to employees and all fatalities arising out of work activities were notified the former by the Department of Social Security and the latter by HM Coroners.

Regulations made under the 1956 Act were written in terms of the duties of employers towards their employees and placed little responsibility upon the self-employed to safeguard their own safety. Amongst some sectors of the agricultural community the philosophy grew up of :the Regulations don't apply to me; it is an infringement of my civil liberties to curtail my activities; and it won't happen to me.

Enforcement of the regulations was by Inspectors of the Ministry of Agriculture Fisheries and Food)later the Health and Safety Executive) and naturally focused upon those provisions relating to employees. Even the introduction of the General Duties provisions of the Health and Safety at Work act 1974, did not lead to a shift towards greater enforcement against the self-employed.

(viii) The costs of accidents.

When an accident happens it is not just the injured person who suffers: the victim will be subjected to pain and discomfort, and probably a financial penalty because of the injury; family and friends will have extra burdens placed upon them and may also suffer financially; employers will lose financially because of the need to replace the victims labour and expertise, and; society as a whole suffers because of the loss of tax revenue and the need to heal and support the victim through the health service and welfare state.

Davies and Teasdale (1994) reported that there are about 38,000 accidents each year in the agricultural industry which involve injury or death, and that they cost to the victims and their families is at least £120 million. What they fail to address is the human cost of accidents particularly when there is a fatality. Often a death from an accident on a farm will lead to the demise of the farm as a business. This is particularly so where a child or close family member is killed on the farm, and for emotional reasons the surviving parents or partner feel that they can no longer continue with the memories that the farm triggers. Alternatively it may be that because of the small numbers of persons involved and their specialisms, there is no-one with the expertise or desire to continue the victims work.

(ix) Specific categories of accident.

Hoskin and Miller (1979) found that over a third of people injured by an animal had had less than one days contact with the animal, and that 28% had more than 6 months. It may well be that those injured on the first day were unaware of the hazard whilst those experienced stockmen injured underestimated the level of risk.

Researchers and Health and Safety professionals have consistently advocated the adoption of Roll Over Protective Structures often against determined cost based opposition from farmers and manufacturers. Countries which have adopted ROPS have seen a decline in their overturning tractor fatalities whilst those Countries where ROPS are not fitted have suffered a continuing high rate of overturning fatalities.

Östberg (1980) reported that whilst experienced Swedish tree-fellers were better than their less experienced colleagues at assessing the relative risks of different situations, they tended to underestimate the absolute level of the risk.

Work in Canada confirms the finding of the current study that flowing grain entrapment is most common amongst boys under 16 years of age, suggesting that the problem is one of lack of knowledge of the hazard.

(x) Education and training.

Studies of agricultural safety education and training have yielded mixed results. Reisenberg and Bear(1980) found that existing education programmes were ineffective in reaching the under 15 age group, and that safety training appeared not to work, since those who had received some training were found to be more likely to be involved in an accident. This may be a reflection of the relevance of the training or simply of a lack of attention to motivation. Stoute and Darbee (1972) found 'conscious risk acceptance, hurry to meet deadlines, and mental distractions....' were factors in agricultural accidents. The present study seeks to provide a more structured approach to such facets of agricultural accident antecedents.

(xi) The focus of agricultural accident research.

Much of the research into agricultural fatal accidents has been directed at identifying groups of accidents sharing certain common characteristics. Those characteristics usually relate to the immediate circumstances of the accident such as what machinery or equipment was involved, or to features of the victim such as their age. The legislative regime and mix of different agricultural and forestry enterprises varies between countries. This naturally influences the kinds of accidents that happen and the direction of research effort. For example, research into forestry accidents is more common in the Scandinavian countries, whereas research directed at evaluating the beneficial effects of fitting safety cabs is more common in the United States where much agricultural health and safety legislation does not apply to most of the population at risk.

Several studies for example Singleton, Ainsworth and Ströder (1984) and World Health Organisation (1986) have recommended that further in-depth studies of all the circumstances surrounding accidents should be carried out. The joint World Health Organisation, Scottish Health Education Group workshop on education for safety was (World Health Organisation 1986) also recommended that those involved in implementing safety programmes should be trained in epidemiological methods so that they understand the need for adequate data collection.

Much recent research highlights the difficulties experienced by safety organisations in all countries, in attempting to influence the health and safety behaviour of people on farms. There is a general interest throughout the research literature in comparing different categories of persons at risk, in terms of the kinds of accident which they have and the injuries that they sustain. Examples include comparisons of employees with the self-employed, and younger versus older workers. Much of the variations identified probably arise from: variations in the assignment of hazardous tasks; differences in the level of safety awareness; as well as the more usually identified variations in experience and maturity. This research seeks to shed further light on these and other issues.

Chapter 3. Origins and orientation of the present research

3.0 Introduction

For many years headquarters staff of the HSE's Agricultural Inspectorate, have prepared a brief anonymised summary of the facts of each fatality. Each summary contains the following details, some of which were coded, others being deduced from the short narratives :

a Sex of deceased

b Date of accident

c County in which the accident occurred

d Employment status of deceased

e Age of deceased

f What the deceased was doing

g Cause of the injury attributed

Summaries were circulated to Agricultural Inspectors, and others, to inform discussion within the industry.

3.1 Early work

In 1983 a Sinclair ZX81 microcomputer was purchased, in kit form, and soldered together. The rudiments of programming were learned and a project was sought which would utilise these new found skills. As the fatal accident summaries for 1977 to 1982 inclusive were readily available, it was decided to devise a database which could be used to store and analyse details of the 490 cases. Seven variables relating to each fatality were stored, and used to carry out a rudimentary analysis. The variables used were Sex, Day and Month of the accident, County, Employment status, Age, and what happened. Subsequently a BBC Model 'B', micro computer was also purchased and used to analyse the accidents.

3.2 Findings of the 1983 analysis of agricultural fatalities

Many findings from the first analysis in September 1983 (Thomas 1983) confirmed preconceptions. For example, the number of child fatalities was found to vary with time of year, presumably in response both to day-length and to variations in the size of the population at risk during school holidays. It was possible, however, to identify a number of insights into patterns of accidents, for example:

- The distribution of people electrocuted was skewed towards the younger age group. In the period from 1975 to 1982 it was found that 31 of the 38 electrocutions (82%) involved a person aged under 30 years. Most (25) being in the age range 18 to 30. It is thought that this simply reflects the population at risk. There are three identifiable accident scenarios which lead to electrocution on farms. In the first irrigation pipes are being moved in a field crossed by overhead power cables. A pipe is moved to the vertical perhaps to allow dirt to fall out, or because the desired fitting is at the other end of the pipe and contacts the overhead cable. Moving irrigation pipes is an unskilled wet dirty job usually allocated to a junior member of staff. In the second scenario a pressure washer is being used when an earth fault develops and the lance becomes live whilst being held by the operator. Again because of its unskilled wet and dirty nature this is work more likely to be done by the youngest, least experienced member of staff. The final scenario involves sheep shearing, where again an earth fault develops resulting in the handpiece becoming live. Sheep shearing is very physically demanding, and payment is usually on piece rates, so it is work that is usually done by younger people.

- Fatalities involving animals (primarily bulls, but also rams) happened almost exclusively to people older than 50. Seventeen (71%) of the 24 people killed by animals between 1977 and 1982 were aged over 50. This is thought to be a simple reflection of the population at risk. On farms it is usually older people who tend animals, perhaps because the young are not prepared to accept the seven day a week commitment of looking after animals. Sometimes a farmer will be semi-retired but still keep a few cattle because they always have. Many of the accidents were not initially fatal but became so when minor fractures led to thrombosis a week or two later.

- The total number of children under the age of 16 killed on farms fell during the six-year period, but reductions in the numbers aged 0 to 5, and 11 to 15, had masked a rise in fatalities for children aged 6 to 10.

- Three-quarters of the children under 7 who died had drowned, whilst accidents involving machinery assumed greater prominence in older children.

- A high proportion of those drowned in grain were found to be youths aged 13 to 18 years. A finding consistent with that reported by the Farm Safety Association Inc. of Ontario (Farm Safety Association Inc. 1985) who found that most victims of this type of accident are under 16 years of age.

- The majority of accidents involving trees happened during the first six months of the year, principally February, April, and May. It is likely that this is due to a combination of factors. In the early months of the year there is more likely to be spare time available to attend to farm maintenance tasks such as tree surgery or felling. Trees may have been damaged by autumn gales, or by snow loading, and the firewood may be needed to heat the farmhouse.

- The number of accidents involving overturning tractors was found to be declining probably because new cabbed tractors were becoming increasingly common. There were 50 people killed in accidents involving overturning tractors during the first three-year period studied (1977 to 1979), but only 21 during the next three years.

- Deaths as a result of falling from moving equipment were more common among children, whereas death arising from falls from a stationary surface increased with age.

3.3 Later studies

Further studies were carried out in 1984, and 1985, (Thomas 1984, 1985a, and 1985b) which updated the earlier findings and gave the Agricultural Inspectorate's headquarters staff, an idea of how the numbers in various categories were varying over time. A further report was prepared for the 'Agricultural Industry Advisory Committee' (Thomas 1985c). It comprised a series of tables relating to the 619 agricultural fatalities which happened between 1977 and 1984 inclusive.

All these studies looked at straightforward factual information about each fatality. The nature of the data precluded exploration of the *causes of* the accidents which had led to the injuries which resulted in death. In the 1985 summary of agricultural fatal accidents (Thomas, 1985c) it was noted that: *'Few of the accidents which have happened in recent years could have been prevented by "hardware" solutions such as greater guarding. Many could have been prevented by "software" solutions such as better training in the recognition and avoidance of dangerous situations'.* These analyses led to the realisation that to reduce agricultural accidents further it would be necessary to identify and analyse the software aspects of accident antecedents. This could be done by comparing accidents with a standardised accident causation model, in order to draw conclusions about the human factors aspects of the accidents, and to make appropriate recommendations for preventive strategies.

3.4 Accident causation models

The following background, and explanation of accident causation models draws heavily on that in the third report 'Organising for safety', of the Advisory Committee on the Safety of Nuclear Installations (HSC 1993a).

The father of the accident causation model is generally acknowledged to be H W Heinrich. In his standard textbook 'Industrial Accident Prevention' (Heinrich 1950), he described a five stage accident sequence, the elimination of any one stage of which would be sufficient to prevent the injury. He represented the model diagrammatically as a single line of five dominoes, each sufficiently close to its neighbours that if the first fell it would in turn bring down the others. In Heinrich's model the **Ancestry and social environment (1)** of individuals leads to **Faults of person (2),** which constitute the proximate reasons for committing an **Unsafe act (3),** or for the existence of **mechanical or physical hazards (3)**, which result directly in the **Accident (4)**, leading to the **Injury (5)**.

Heinrich argued that the elimination of even one of the stages (dominoes) would interrupt the accident sequence and prevent the injury event from occurring. He viewed the middle domino, which he labelled unsafe act and/or mechanical or physical hazard, as being the most important, arguing that since the work of the accident prevention engineer relates directly to the prevention of the accident, his activities should centre upon the factors immediately preceding the accident itself. Heinrich also argued that since 'unsafe actions and conditions are wholly practicable of determination by means of observation and enquiry, preview of records, survey and inspection *before* they result in accidents,' they should be at the heart of an efficiently functioning accident prevention programme. Where preventive activity is restricted to a minimum, action against the immediate cause of accidents may alone be effective.

Bird and Loftus (Bird and Loftus 1976) expanded Heinrich's model, to reflect the role of management in the prevention of accidents, and the range of different outcomes that may arise from accidents (i.e. injuries of different severity's, property damage events or incidents that do not result in a quantifiable loss). Like Heinrich they represented their model as a line of five dominoes, but stressed the '*multilinear interactions* of the cause and effect sequence'. In Bird and Loftus's accident model the stages are:

- **Loss** is defined not just in terms of personal injury, but also incorporates harm to Property and Processes which arises from an

- **Incident/Contact** that involves a contact with energy or a substance with a magnitude greater than the threshold that a body or structure can withstand.

- **Immediate causes** are the circumstances that immediately precede the contact event, and are categorised as either substandard acts or conditions. Underlying the Immediate Causes are the

- **Basic Causes** which cause or permit the immediate causes to arise and continue to exist. Underlying the Basic Causes is a

- **Lack of management control** arising from inadequacies in the planning, organising, leadership and control of operations for which management has responsibility.

Heinrich's and Bird's models represent accident causation as a single sequence of actions or failures leading up to the injury (loss event). There is a danger that investigators using the models will try to fit the facts to this single sequence rather than directing their attention to the overall situation of which the accident forms a part.

Rasmussen (Rasmussen 1987) refers to this as the 'stop-rule' which he defines as:

'...an event will be accepted as a cause and the search [for further causes] terminated if the causal path can be followed no longer, or a

familiar, abnormal event is found which is therefore accepted as explanation, and a cure is known.'

One system that fully addresses the question of multi-causality is the Management Oversight and Risk Tree (MORT). This was developed in the early 1970's by Johnson for the US. Atomic Energy Commission, Division of Occupational Safety (Johnson 1975). MORT is described as 'a complex analytic procedure that provides a disciplined method for determining the causes and contributing factors of major accidents.' The system identifies and probes nearly 300 problem areas, in 3 major areas of concern:

- Specific oversights and omissions,
- Assumed risks, and
- General management system weakness

With over 300 questions the MORT system is extremely complex and demands vast resources to apply properly. Early analyses using the system and reported by Johnson (Johnson, 1975) illustrate the multi-causal nature of accidents. Five accidents that had previously been investigated and reported upon by 'technically sophisticated personnel' were analysed using MORT. The initial analyses revealed an average of 18 contributory factors, but MORT identified on average, a further 20 problems for each case.

This multi-causality is neatly described by Reason (1990) when he argues that major disasters 'arise from the unforeseen and usually unforseeable concatenation of several diverse events, each one necessary but singly insufficient to cause the catastrophic breakdown'. He goes on to examine the similarities between the aetiology of industrial accidents and certain multi-cause illness', and to propose the analogy of a 'resident pathogen' metaphor.

Under the 'resident pathogen' metaphor there are, like pathogens in the body, a number of latent defects or failures which are constantly present. They will tend to encourage unsafe acts, or undermine defence mechanisms, and will remain dormant until triggered by an active failure. The early detection and correction of latent failures is important. Not only might several different active failures be prevented from coming to fruition by the correction of one latent failure, but the detection and correction procedure will provide a vehicle for senior managers to become actively involved in accident prevention.

Rasmussen (Rasmussen 1987) proposed a system for classifying errors according to the level of functioning of the person at the time they made the error. He classified errors into those which were skills, rules, and knowledge based.

Skills based errors involve slips or lapses, which occur whilst carrying out an automatic action in response to an external stimulus. For example the typist hears a letter and types it, the joiner hits a nail.

Rules based errors occur when the person is behaving in a slightly more complex way and include the misclassification of a situation. For example a driver correctly executes the procedure to turn left at the traffic lights on the way to work, but should have turned right to collect a colleague.

The third of Rasmussen's classifications, knowledge based errors, occur when the individual is engaged in problem solving. For example a motor mechanic (or Doctor) incorrectly diagnoses a problem based upon the misinterpretation of symptoms. Some of the rules and knowledge based errors that occur do not happen unconsciously, but involve the deliberate flouting of an accepted procedure or practice. These are referred to as violations.

Unless it is known whether errors by the victims and others parties involved, are skills, rules, or knowledge based, or are violations of some rule or accepted procedure, it is difficult if not impossible to devise an appropriate preventive plan. For example knowledge based errors are clearly susceptible to training and the training can be identified quite clearly from the kinds of errors made. On the other hand lapses, which are skill based errors are not amenable to further training, since the participants are already highly trained and so the problem can only be dealt with by for example. improved ergonomic design. Moreover it is important to know whether the accidents are occurring because the deceased, fellow workers etc. are making errors associated with not knowing whether the hazard exists, not being able to identify and correctly assess the risk, not knowing what the correct course of action is, or not being able or prepared to take it.

When seeking to devise the most effective accident prevention programmes, a number of factors must be considered. In addition to establishing whether the problem to be addressed arises from skill, rule, or knowledge based errors, we also need to take account of the multi-causal nature of accidents, the presence of active and latent failures. Only when the problem has been correctly diagnosed and its extent evaluated will it be possible to select, implement and monitor the most appropriate preventive actions to avoid both active and latent failures.

Hale and Glendon (1987) have devised an input-output model which describes, human behaviour in the face of danger. The model not only categorises failures in terms of skill, rule, and knowledge based errors, and violations, but also describes the failures in terms of the risk assessment and control cycle. The Hale and Glendon model is shown at Figure 3.1.

3.5 Hale and Glendon model

In the Hale and Glendon model, the skill, rule, and knowledge elements are represented vertically, whilst the risk assessment, and control regime is denoted by the horizontal flow of the input, process, output model.

The model seeks to describe the way people at work look for and deal with hazards that place themselves or others at risk. It is presumed that some danger is always present, but that no harm has yet occurred.

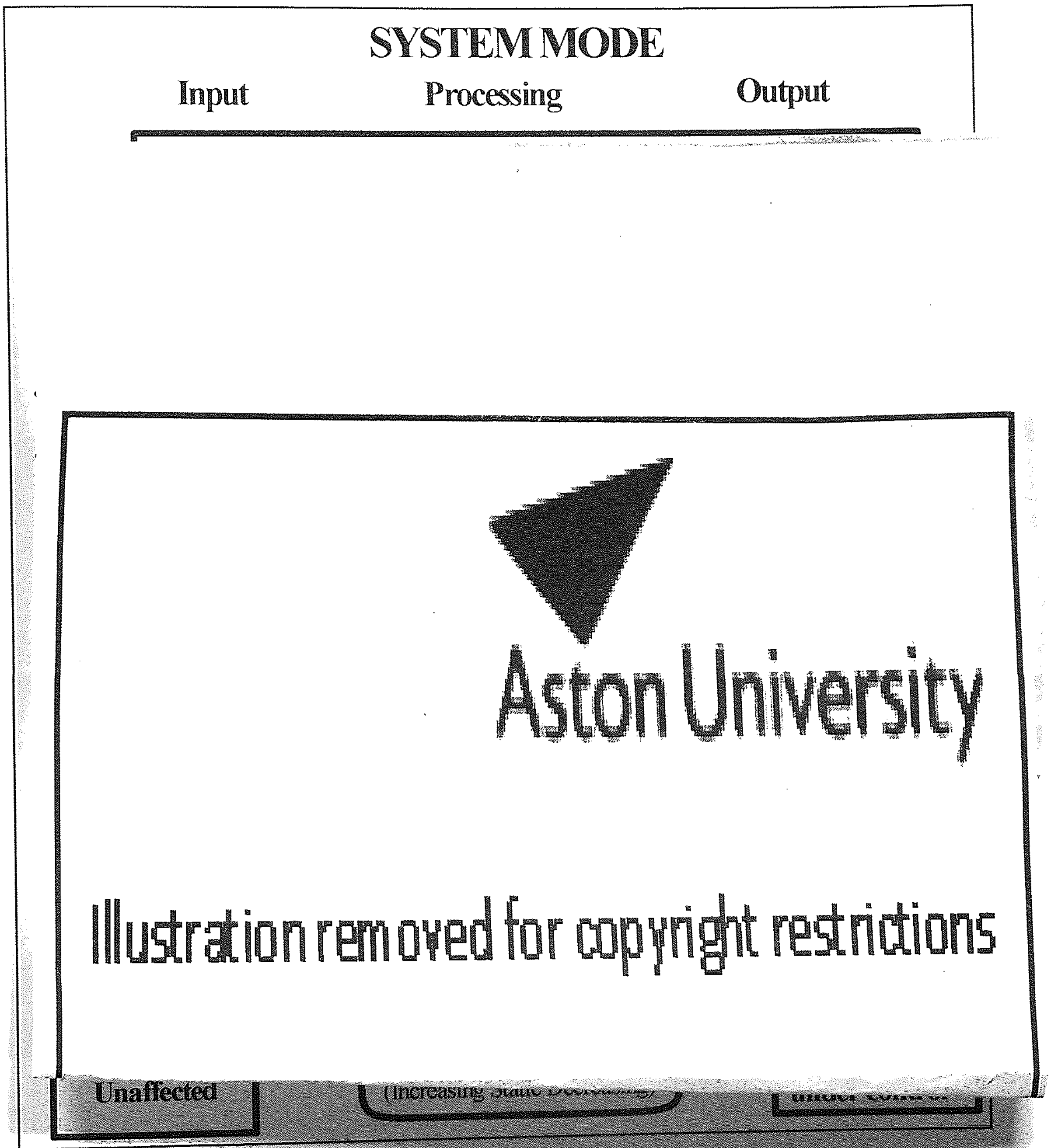


Figure 3.1 Hale and Glendon model of behaviour in the face of danger (Source Hale and Glendon, 1987)

For the purposes of this research, the harm considered was an accident that resulting in death, but it would be just as easy and valid to use the model to consider any level of undesired result. The left-hand or 'input' phase of the model is concerned with the identification of hazard, the central 'processing' stage with risk assessment, and the 'output' stages on the right-hand side of the model describe the selection and adoption of measures to reduce the level of danger.

The feedback loop in the model emphasises that the process of hazard detection, assessment, and control is iterative. Danger will increase, reduce, or remain the same, depending on how it is responded to, and upon the effect of other outside influences.

To work safely people must have: sufficient knowledge and skills, they must know the rules, and must be motivated to:

- look for and correctly identify hazards;
- assess and prioritise those hazards, or at least recognise the need for action;
- personally accept or ensure the proper allocation of responsibility, *for correctly* dealing with the hazards;
- know what should be done;
- possess the skills to take the appropriate actions, and;
- monitor the adequacy of those actions, taking further corrective action if necessary.

The Hale and Glendon model is based primarily upon Rasmussen's skills, rules, knowledge hierarchy and, although not separately shown includes implicit recognition of the importance of violations. It can be used to describe both latent and active failures, and is consistent with the concepts of hazard identification, risk assessment and control subsequently introduced under the Management of Health and Safety at Work Regulations 1992.

The model is also flexible enough to be used not only to examine the behaviour of people close to the seat of accidents, but also to identify errors made by those more remote in time or space. As Booth (1993) put it in his address to the Institution of Environmental Health Congress: *'....machine designers require appropriate knowledge and skills, and an understanding of the rules, and a commitment to health and safety, to ensure that they take appropriate steps to design safe and healthy products. The same requirements are appropriate for supervisors and managers who are responsible for creating and maintaining a safe working environment, as well as personnel on the shop floor directly exposed to risk.'*

3.6 Summary

This research arose out of simple analyses of agricultural fatal accidents carried out in the early 1980s and originally designed to test newly learned computer skills. The studies involved analyses of the summaries issued to Inspectors and covered agricultural fatalities that happened between 1977 and 1984.

It was expected that information of value for accident prevention, could be gained from a deeper analysis of the errors made by those involved in the accidents. By knowing whether errors by the victims and other parties involved, are skill, rule or knowledge based, or are violations of some rule or accepted procedure, it should be possible to devise effective preventive strategies. The Hale and Glendon accident causation model allows errors to be categorised in this way, and also in terms of the hazard identification, risk assessment and control process.

Chapter 4. Research objectives and methodology

4.0 Objectives

The objectives of this study were to:

Attempt to demonstrate by an analysis of fatalities in one industry using a model of accident causation, that it is possible to identify groups of victims linked by common types of failures leading to specific kinds of accident or injury.

Identify and to assess the relative usefulness of strategies which could be used to prevent future injuries.

Seek to assist HSE in the development of an efficient and effective accident investigation, recording and analysis procedure, geared to the identification of targets for prevention.

Examine the suitability of the Hale and Glendon model (Hale and Glendon 1987) for such purposes, either alone or in conjunction with other techniques, and to propose appropriate enhancements.

4.1 Data availability

At the time the reports considered in this study were made, the system of investigation and reporting used by Agricultural Inspectors was as follows:

- after any inquest into the death is completed the Inspector primarily involved in the investigation prepares and submits a report;

- the reports are almost always prepared or at least vetted by, the local Principal Agricultural Inspector.

- a copy of the report and any associated documentation is forwarded to the Agricultural Inspectorate's Headquarters where the circumstances are considered and it is decided whether or not the accident is to be recorded as an accident at work in the industry;

- having confirmed that the accident is to be counted, the coding and wording of the summary to be input to the computer system is agreed

- following input the reports are numbered and kept together with any associated papers in boxes in year order, to be used for the preparation of summaries for Inspectors and for the media;

- boxes of reports from previous years and no longer required for immediate use are transferred to HSE's warehouse for long term storage. It was these boxes of reports which were used for this research.

The reports follow a standard format, with slight variations over time and according to how much detailed information is available. Reports from Scotland follow a slightly different format because inquests are rarely held. There were a number of cases where the circumstances came to the inspector's attention some time later in which case the report might contain only very brief details.

The standard report is used to record factual information and is divided into a number of sections. In the first section is recorded details of the deceased, such as name, age, gender, employment status etc. In the second section is recorded details of the inquest, such as when and where it was held. The third section recorded where and when the accident occurred, what happened, details of any equipment involved, what legislation applied, and the names of those giving evidence at the inquest. The final section of the main report contains brief details of the evidence presented, and any comments by the investigating Inspector.

Often there is also a separate brief report attached in which the investigating Inspector gives a fuller and franker account of the accident.

Almost all of the reports are supplemented by associated papers. Usually there is a copy of the message sheet recording the initial brief details of the fatality. Other papers bundled with the reports include: witness statements, usually taken by the Police; reports prepared by the police which are often presented in statement form; post-mortem reports; newspaper reports; and occasionally Coroner's notes of the inquest.

4.2 Data quality

The quantity and quality of the information available, and the character of the reports was found to be variable. Individual inspector's perceptions of what was or was not important appeared to have a major influence upon the reports. In order to try and evaluate the quality of the reports in a more structured way they were examined using mind maps (Buzan, 1982). Mind maps are a system of recording information and ideas in an open ended, non linear way. Starting with a central idea, information and thoughts are recorded radiating from the centre *'.....and branch out as dictated by the individual ideas and general form of the central theme.'* As the map progresses key ideas can be linked, leading to an almost pictorial representation of the ideas and information provided.

Twenty reports were selected at random and examined in this way, in order to assess what information was available and capable of being analysed, and what information was missing. The author's initial views on the shortcomings of the data were recorded at the time and are listed below:

- The content of the reports appeared to be affected by the possibility of litigation. In some cases the inspector may have decided not to prosecute so would naturally complete a report which would not contradict such a decision. This may have led to information about relevant features being excluded from the report where the subject area may in fact have been explored by the inspector. In some cases the importance of certain factors may have been underplayed. Particular problem areas were:

- identification of breaches of existing regulations which were of no relevance to the accident cause or injury severity;

- situations where the evidence is disputed, and the most direct witness of fact was the deceased. e.g., the employer said that he told the deceased to do something but it was impossible to confirm or refute it as the deceased was not available for comment;

- Reports may also be affected by fear, of criminal or civil proceedings of those interviewed. These biases would not be random and will depend on the circumstances of individual cases, e.g.:

    - if the deceased is perceived to be at fault, the report may emphasise this culpability at the expense of others' misdemeanours;

    - in cases where existing, often absolute, regulations do not apply, e.g. to the self-employed, people are less likely to feel threatened so would be inclined to be more forthcoming;

    - situations where an unnamed/unidentifiable third party can be blamed, e.g. designer, then a more objective, complete report could be expected.

- A further source of bias arises from the law on the disclosure of information. Inspectors may be inhibited from expressing opinions which may subsequently be disclosed. This would be expected to lead to the exclusion of matters which may be germane but unprovable, and/or potentially libellous.

- Similar problems may arise with the Data Protection Act (1984) where information is recorded on computerised systems. Thus, all that would be recorded would be a 'sanitised' version of provable facts.

- There appeared in some cases to be a reluctance to look beyond long established regulations, (e.g. those made under the 1956 Act rather than under the HSW Act) to discover deeper causes of the accident/injury. A number of questions were hardly ever addressed explicitly in Inspectors inquest reports. For example:

    - Were the existing regulations adequate?

    - Were they being suitably, sufficiently and vigorously enforced?

    - Could the accident/injury still have happened (perhaps at a lower level of severity) even if the existing legislation had been complied with?

- Often there was an apparent reluctance to look beyond those present at the time of the accident/injury, e.g. to designers, suppliers, installers etc. Part of this problem in the early years of the HSW Act may have been due to the phrase in the wording of Section 6 - 'when properly used'. In agriculture a requirement similar to that in Section 6 already existed, although only in respect of field machinery. The Agriculture (Field Machinery) Regulations 1962 at Regulation 4, prohibit the sale and letting or hire of (new) non-complying field machines.

- Factors which were potentially of interest were often not mentioned, placing the researcher in the dilemma of not knowing whether or not they were considered. Or, if they were considered, were they considered in sufficient depth and detail, and found not to be relevant (in the inspector's opinion). It would obviously be preferable to know whether a particular factor had been considered. Education/training may or may not have been mentioned. If it was, it was usually in terms of 'the deceased was an experienced worker'. Normally there was no indication whether this experience or training was of direct relevance to the task at the time of the accident, nor were there objective measures of the factor. Some examples of what could have been recorded are:

- the Deceased Person (DP) had 10 years experience as a stockman, but was without formal qualifications;

- tractor driving test passed, national proficiency test certificates obtained, x years before;

- day release classes attended but no formal qualifications. However - not experienced in task being performed.

- There was a dearth of evidence about the physical condition or mental demeanour of the deceased immediately before the accident. In some cases physical deficiencies were listed in the pathologists reports - e.g. diabetes, deafness etc. Very seldom were fatigue, mental preoccupation, anger or other 'mental' characteristics of the deceased mentioned. It may be that such things were considered to be irrelevant, i.e. regulations apply irrespective of the mental or physical state of the deceased. Very seldom was there consideration of whether mental or physical attributes predisposed that person to any particular type or severity of injury.

- An initial impression was of a large number of cases where compliance with existing legislation (i.e. specific regulations) would have prevented the accident but for the deceased being just outside the scope of that legislation - e.g. a self-employed farmer working on a farm where there are no employees, killed on a power take-off, or driving a tractor without an approved safety cab, or a situation where children are using machinery.

- Technical aspects of how the accident happened were generally well recorded, reflecting inspectors' technical/hardware competence. Usually there was an emphasis on hardware, with less detail about the persons involved and the possible motives which led them to take certain courses of action.

- There was much less coverage of those measures that could have been taken which would have prevented the accident, or decreased the severity of, or prevented the injury. Hence, there was no discussion of possible preventive strategies, their relative importance, and their chances of success.

- Coverage of such things as experience/training/instruction was minimal unless there was seen to be a direct link between it and the accident's immediate cause. Comments on the quality of training were non-existent. Where training was mentioned there was no assessment of its relevance for prevention of a particular accident.

- Many of the fatal injuries appeared to happen when people were doing tasks that were not part of their normal work. Comments about training/experience were usually related to their normal work rather than to the specific task being undertaken.

- The quality of reports in terms of their relevance for providing information about prevention of future accidents was variable. There was often a marked difference between inspectors, police, and coroner's comments as reported in the inspector's report, e.g.:

    - Police - reports by police constables were highly structured and formal and appeared to include everything, irrespective of whether factors were relevant, and were thus very useful for this research.

    - Inspector's reports - covered primarily those points which the individual inspector perceived as being most important. There was minimal emphasis on ostensibly less crucial matters. Often there was no indication that things had been considered but not thought relevant.

- Coroner's comments - these of course were selectively reported by inspectors but where they were reported, appeared to be objective and of potential use. Coroner's notes of inquests may provide a source of further information. Inquests are carried out without thought of possible future prosecution or civil litigation. The objective of an inquest is to investigate in a dispassionate manner, the circumstances in which the deceased met their death. As inquests focus on the circumstances immediately surrounding the death rather than the build up to the accident, Coroner's notes are likely to be of little use in identifying latent defects.

It was concluded that whilst the quality of the data was variable, it represented a potentially rich source of information about accident causation, and it would be possible to analyse it using the Hale and Glendon accident causation model.

4.3 Proforma development

The Hale and Glendon accident causation model (see Figure 3.1) was originally designed to be used within the structure of a text book, for explaining behaviour in the face of danger. In order to be able to use it for analysing accidents it was first represented as an event tree (Booth, 1992) then transformed into a matrix structure, that could be used for coding the errors identified during the examination of the Inspectors reports.

During this development process, a number of problems were identified. These concerned the completeness of the logic of the model, the fact that it did not conform to an event-tree structure, and the lack of an explicit distinction between unintended errors, and violations.

The Hale and Glendon model distinguishes between the allocation and acceptance of responsibility for action, and the execution of that action.

However, in the case of testing for danger, it combines together the acceptance of responsibility with the execution of the test for danger, i.e. it does not separately distinguish the allocation and acceptance of responsibility for hazard seeking. An extra step was included in the matrix to differentiate the acceptance of responsibility for testing, from the execution of the test.

In the feedback loop of the Hale and Glendon model the result of the errors is shown as not affecting the level of objective danger, i.e. the danger will continue at its current level which may be static, increasing or decreasing. However there may be situations in which the occurrence of the error does influence the level of danger, either benignly or in an undesirable way. In some situations an error may accidentally make the situation safer. The following possible outcomes of errors, only some of which are undesirable in health and safety terms, were identified:

- a static level of danger may be boosted to a higher level, or changed to an increasing or decreasing one;
- the rate of increase of a rising danger may be unaffected, or its rate accelerated or decelerated;
- the rate of decline of a danger may be unaffected, accelerated or retarded;
- a combination of the above effects.

Examples of situations that might lead to the different results outlined above would include:

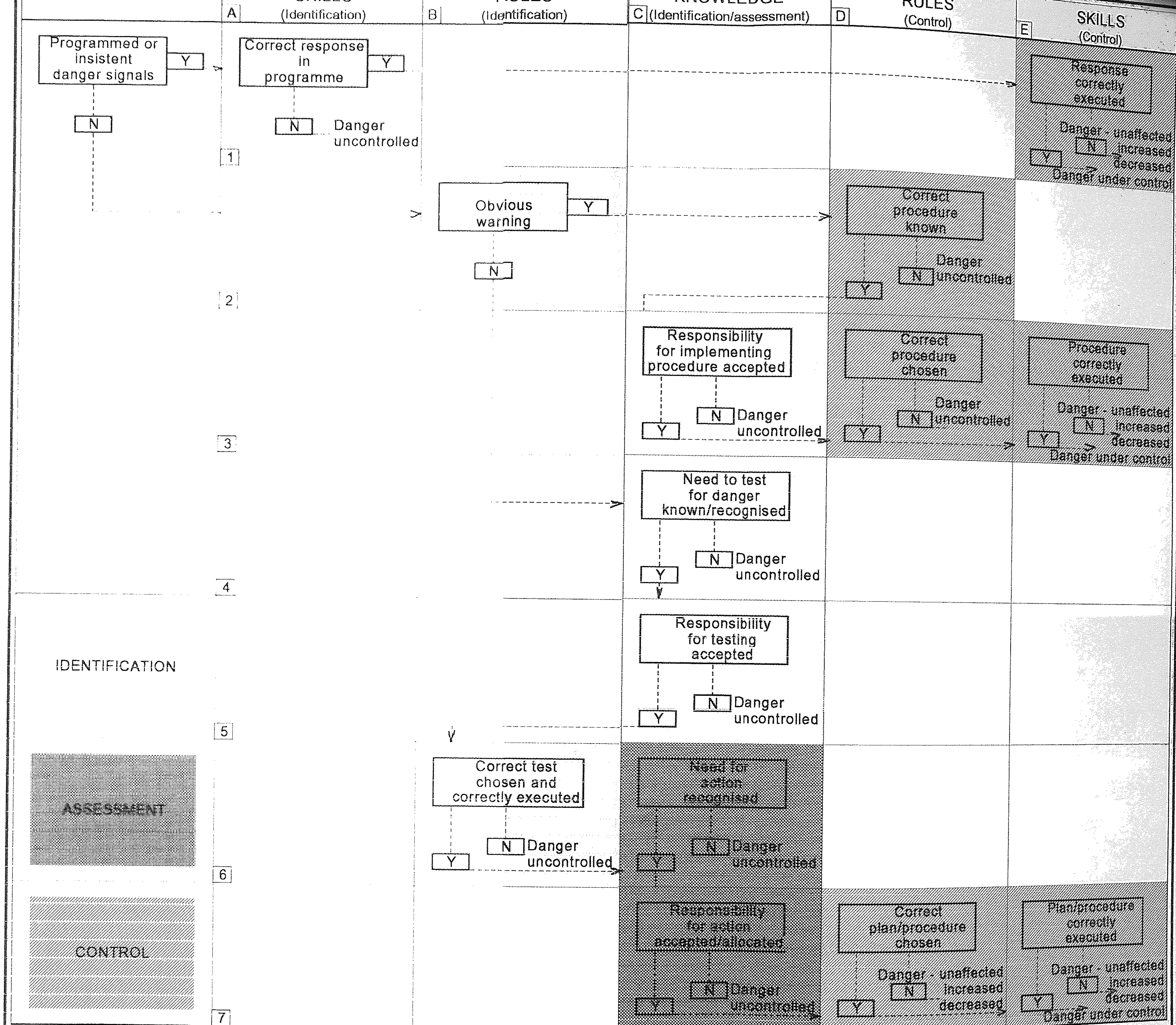
- failure to properly execute a procedure leading to an increase in the rate of evolution of a toxic gas;
- carrying out the wrong test which produces a false positive result, leading to the application of the wrong control measure which nevertheless reduces the danger;

- a failure to identify that a safety system is inoperative would increase the static level of danger, whereas a failure to identify that its effectiveness is declining would lead to an acceleration in the rate of increase in the level of a danger.

The matrix that was developed from the Hale and Glendon model, was arranged in the form of a event tree, with the logical changes mentioned above incorporated. Unintended errors and deliberate violations of known procedures and practices were distinguished. The effect upon the overall level of danger that the commission of different kinds of error was likely to have, was also highlighted. (see Figure 4.1)

For the purposes of this research, the matrix was used in the following way. Having examined the Inspectors report and any associated papers relating to a particular fatal accident, all of the parties who were involved in the accidents antecedents were identified. Each of the parties starting with the deceased were considered in turn, by starting at the top left-hand corner of the matrix, and following the trail left by the YES answers. Eventually the point at which the error occurred was identified since the answer was NO. All that was necessary then was to read the row and column markings and record the matrix co-ordinates e.g. B6.

The first error considered was termed the proximate error of the victim. This is analogous to Reason's active failure, i.e. the one that precipitated the accident happening. Next for consideration were any earlier failures by the deceased which were distant in time from the locus of the accident. Subsequently considered were failures by others involved. Generally they were distant in time and space from the accident. These distant failures are analogous to Reason's latent failures.



A (Identification)
B (Identification)
C (Identification/assessment)
D RULES (Control)
E SKILLS (Control)
Programmed or insistent danger signals
Y
N
Correct response in programme
Y
N
Danger uncontrolled
Response correctly executed
Danger - unaffected increased decreased
Danger under control
1
Obvious warning
Y
N
Correct procedure known
Danger uncontrolled
2
Responsibility for implementing procedure accepted
Danger uncontrolled
Correct procedure chosen
Danger uncontrolled
Procedure correctly executed
Danger - unaffected increased decreased
Danger under control
3
Need to test for danger known/recognised
Danger uncontrolled
4
Responsibility for testing accepted
Danger uncontrolled
IDENTIFICATION
5
Correct test chosen and correctly executed
Danger uncontrolled
Need for action recognised
Danger uncontrolled
ASSESSMENT
6
Responsibility for action accepted/allocated
Danger uncontrolled
Correct plan/procedure chosen
Danger - unaffected increased decreased
Plan/procedure correctly executed
Danger - unaffected increased decreased
Danger under control
CONTROL
7

The following examples are included to illustrate how the codings were arrived at :

Due to a fault in the starter circuit of his tractor, the deceased a 51 year old tractor driver, was attempting to start it using a piece of wire connected between the coil and the starter motor. Whilst standing on the ground, he started the tractor which as it was in a low gear, ran forward damaging a wall. Still standing on the ground, the deceased attempted to select neutral but inadvertently selected reverse gear, and was run over by the reversing tractor. The accident was coded:

- E1 (proximate failure) by the deceased who was operating at the skills level in attempting to escape from the reversing tractor. He failed to correctly execute his response.

- D7 (distant failure) by the deceased who was operating at the knowledge level when, having identified a fault in the tractor's starter circuit, he chose the wrong procedure to deal with it. i.e. rather than rather than remedy the fault, he attempted to circumvent it.

- D7 (distant failure) by a colleague who also knew of the fault and connived in the execution of the wrong procedure.

- C6 (distant failure) by the employer who knew that there was a problem with the starter circuit but did not recognise that he needed to take action.

The deceased was a 40 year old experienced General Farm Worker who was moving irrigation pipes. He swung a pipe vertically through 90° in order to reverse the couplings. The pipe contacted an 11 kV overhead power line. Deceased was experienced, well aware of the hazard (he had previously warned others whom he was supervising), and had been instructed in the system of work to be adopted, less than 24 hours previously. The accident was coded:

C3 (proximate failure) by the deceased who despite knowing the correct procedure, failed to accept responsibility for implementing it .

- E7 (distant failure) by the employer, who despite having implemented a procedure for safe handling of irrigation pipes adjacent to power lines, failed to ensure that it was correctly implemented.

4.4 Coding framework

In addition to the coding of the accident on the causation matrix each was described by means of a number of other variables. The variables and their descriptions are as follows:

Serial number - Used to identify absolutely, each fatality recorded in the research, and to facilitate reference back to the original papers.

COFFIN - Used to record the serial number of each record on HSE's fatal accident database.

NACE Industry code - Used to record the main economic activity of the enterprise in which the deceased was engaged at the time of the accident.

Date - Recorded the date of the injury, or the best estimate if unknown.

Place - A four figure Local Authority code from which Counties could also be deduced.

Day - Used to show the day of the week on which the accident happened. Automatically calculated from the date of the accident.

Time - The time when the accident happened

Length(s) - Used to record the normal length of time that the deceased should have worked on the day of the accident: hardly ever recorded in the reports.

Time(s) - Used to record the number of hours after the start of the shift that the accident happened.

Kind - Used to record the kind of accident that happened. The codes used were the same as HSE uses on the MARCODE database. Each accident is classified into one of 18 broad categories, such as Transport, Trip, Machinery, Struck by, Fall etc.

Agent 2 - Used to record a second keyword relating to the agent of the injury. The same as HSE uses on the MARCODE database were used. Agent 2 codes are linked to Kind codes, and more precisely describe the accident. For example where 'Kind of accident' is coded as 'Trip' (i.e. a slip, trip or fall at the same level), the linked Agent 2 codes describe the surface on which the slip occurred, e.g. slippery, uneven, obstructed etc.

Verdict - Recorded the verdict if an inquest was held. The coding also indicated whether or not the jury (if any) qualified their verdict with a rider. Riders are very uncommon. They may for example involve a request that the case be widely publicised, or that relevant standards should be modified.

Age - Recorded the age of the deceased person. (at the date of the injury rather than death).

Sex - The gender of the deceased.

Status - A two digit code used to record employment status. the first figure indicated the deceased's job title (self-employed, tractor driver, stockman etc.) and the second figure showed how fully they were employed (full or part-time, casual etc.).

Survival - Recorded the time which elapsed between the injury and death.

Occupation - A three digit code describing the occupation of the deceased. The first digit indicated the industry, agriculture, horticulture etc., and the second and third digits described what the deceased was employed as e.g. general labourer, director, foreman, pigman etc.

Job(e) - Used to record the length of the deceased's experience in the general type of work for which they were employed. Such information was not generally available in the reports. Where it was available it was expressed in qualitative rather than quantitative terms.

Task(e) - Used to record the length of the deceased's experience of the task they were undertaking at the time of the accident. The information was not generally available in the reports. Where information was available the seasonal nature if some agricultural tasks made the results of dubious value.

Job(t) - Used to record the level of training in general farmwork, that the deceased had received. There was little useful information recorded in the reports.

Task(t) - Used to record the task related training that the deceased had received. There was little useful information recorded in the reports.

Site - Recorded the part of the body that sustained the main injury that led to death.

Nature - Recorded the nature of the most serious injury, e.g. fracture, crushing, burns etc. Also recorded was the cause of death, shock, haemorrhage etc.

Task(i) - Used to record the extent to which instructions in the specific task that the deceased was engaged in had been given, and the quality of that instruction.

Task(s) - Used to record the amount and quality of the supervision provided for the deceased.

Medical condition 1 - Used to record medical or physiological conditions that may have increased the risk of the deceased having the accident. A three figure code was used. The first digit indicated the extent to which the condition existed, the second recorded the extent to which the condition contributed to the accident happening, and the third, the nature of the condition.

Medical condition 2 - This variable was very similar to Medical condition 1, but was used to record medical or physiological conditions that may have increased the chances that that particular victim would die as a result of that particular injury.

Party - Used to record the category of person or body whose behaviour was being compared against the accident causation matrix. Categories included employer, supplier, designer, colleague etc.

Point - Recorded the point on the matrix at which the failure by the party occurred, together with an assessment of the extent to which expert judgement had to be exercised in determining the correct matrix cell.

Significance - used to apportion between the parties their relative power to have prevented the accident.

Adequacy - Intended to be used to score each report in terms of the extent to which it provided adequate information upon which to base decisions about coding. Not used.

4.5 Data input and checking

The reports and other papers relating to each of the accidents were considered in turn. Each of the variables described above was coded and the information transcribed onto a data input form, (see Figure 4.2) to which was added a brief narrative account of each of the cases. The narrative accounts together with the coding of the points on the matrix at which the errors occurred are reproduced at Appendix 1.

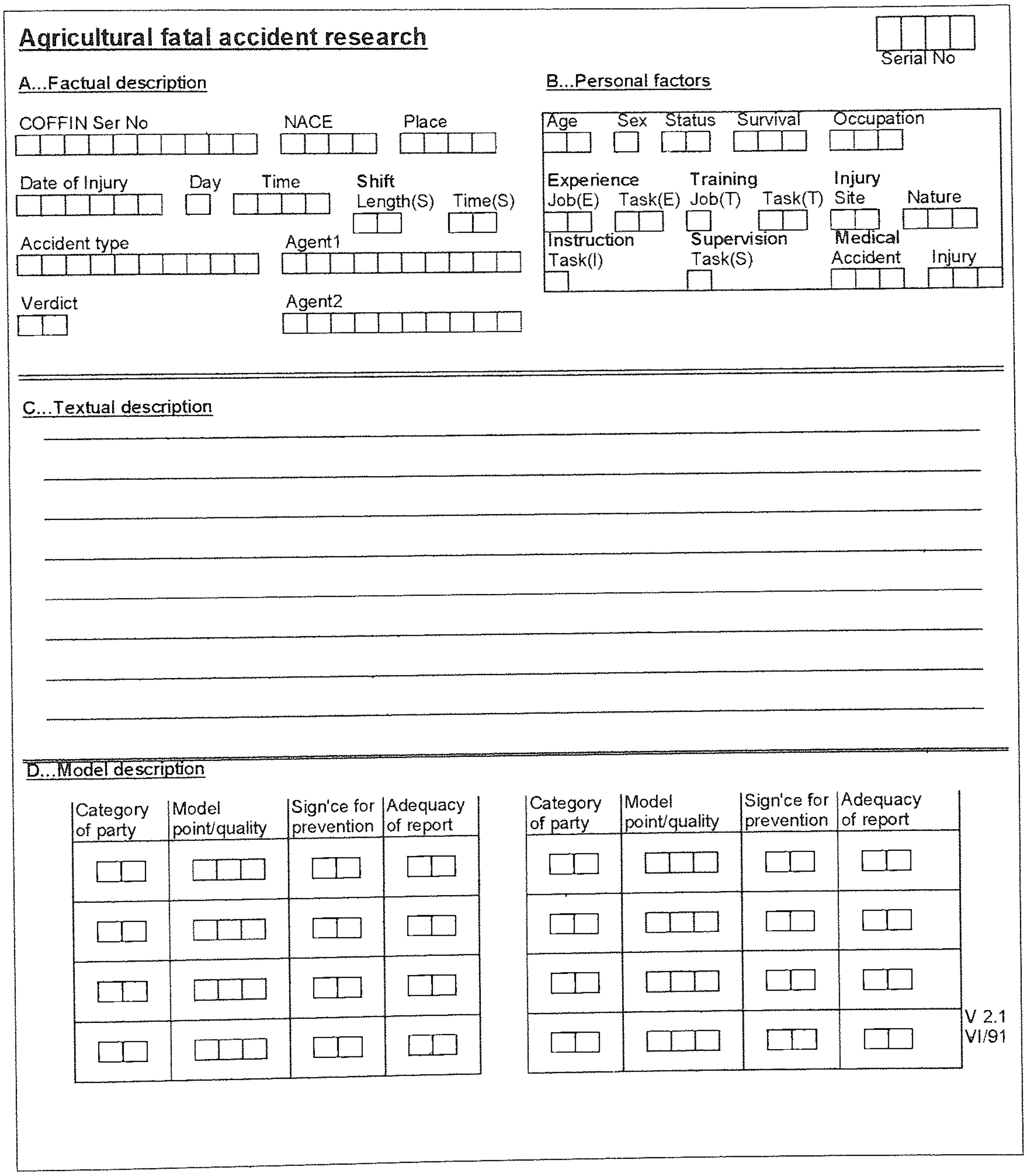


Figure 4.2 Data input form

Having completed the data input forms the information was input into a combined spreadsheet, database, and presentation programme, Microsoft Excel 3.0 (subsequently 4.0). The data was arranged as a database with each case occupying one row, and each column containing all of the values for one variable. Prints were made of the data and randomly selected cases were compared against the input forms, and the original reports. Very few discrepancies were discovered. Where a mistake was found all other cases sharing that characteristic were also checked.

A standard format was devised by means of which cases sharing certain common characteristics could be extracted from the database and the values of their variables displayed by means of a series of standardised graphs and tables. This means of presentation facilitated the rapid comparison of groups of case sharing common characteristics. The standardised series of graphs and tables have been translated into the Ami Pro word-processing program in which this thesis has been prepared, and examples can be found at the end of Chapter 5.

A crucial concern relating to data quality and coding is the extent to which the coding was influenced by the subjective judgement of the researcher, for example in:

(i) the selection for coding of the key errors made by participants;

(ii) the actual code allocated to particular errors. Here the researcher sometimes was obliged to use his extensive experience as an agricultural inspector to 'fill in' details not explicitly included in the accident reports. Moreover some reports in any event contained the subjective judgements of the investigating inspectors.

A panel of agricultural and accident investigation experts was brought together to review the reliability of the coding in the light of the above and other issues. The results of this study are described in detail in Chapter 6.

4.6 939 Agricultural fatalities 1/1/79 to 31/12/92

To assess how representative the three years cases studied against the accident causation matrix were, of agricultural accidents over a longer period, it was necessary to construct a database containing a larger number of cases. For this extractions were made from HSE's two computerised databases of fatalities, AGCOFFIN, and PERMCOFFIN. The AGCOFFIN database contains details of fatal accidents investigated by Agricultural Inspectors between the beginning of 1981 and April 1986, when it was replaced by PERMCOFFIN which contains similar details for the more recent fatalities.

Variable name	Description
AREA	HSE Area in which the accident happened.
DATE	Date of accident.
DAY	Day of the month e.g. 2nd, 30th etc.
MONTH	Month of accident.
YEAR	Year of accident.
WEEKDAY	Day of accident (Sunday to Saturday)
COUNTY	County in England and Wales, Scottish Region.
NATINJ	Nature of injury that led to death, e.g. fracture etc.
SITEINJ	Part of body affected
TIME	24 hour clock, best estimate where body not found immediately
SEX	Male or Female
AGE	To nearest year e.g. 0 to 86
KIND	Kind of accident e.g. Machinery, Transport etc.
AGENT	Agent of injury e.g. tractor, ladder etc.
SICR80	Standard Industrial Classification e.g. 0100, 0200

Table 4.1 List of variables recorded in the comparison database

The coding frameworks used for the two databases are different, but they do contain a number of common features. For example the date of the accident is always recorded, as is age, sex and kind of accident, although the codes used vary between the systems. By extracting the data and systematically re-coding the earlier fatalities to the later coding framework, it was possible to build up a comparison database containing 15 variables as shown in Table 4.1.

In addition it was also possible to make an extraction of the same variables for those accidents that happened in 1979 and 1980, which were examined in detail against the accident causation model. The variables were then translated to the most recent (PERMCOFFIN) coding framework, and added to the later records.

The result is a database consisting of all those agricultural fatalities recorded in official published statistics as having happened between 1/1/79 and 31/12/92. Each of the 939 cases is described by the 15 variables shown in Table 4.1.

This database will remain available to HSE and could be extended to encompass subsequent fatalities. For the purposes of this research it was simply used to assess how representative the three year sample compared with the accident matrix was of all of those accidents that happened between 1/1/79 and 31/12/92.

Chapter 5. Fatal accidents in agriculture - Results

5.0 Introduction

In order to facilitate clarity in the presentation of the results the data has been laid out in the following way.

In Section 5.1 there is presented a comparison of the results from the 230 fatalities examined in detail against the model, with the less detailed analysis of all of the 939 agricultural fatalities that happened between 1/I/79 and 31/XII/92. A brief description of each of the 230 fatalities examined in detail is given in Appendix 1. They are numbered from 8 to 258, but there are several numbers missing. This is because the initial sample of 20 randomly selected cases were numbered from 1 to 20. Thereafter the 230 cases in the three selected years were numbered from 21, with Case 8 being the only one in both selections. Following the allocation of numbers, several cases had to be excluded, where death was found to be due to a chronic disease.

Section 5.2 to 5.9 describe the results in narrative format, commencing with an overview of all 230 fatalities (5.2). This is followed by reviews of the data relating to particular categories of victim, distinguished by their employment status, the Self employed (5.3), Employees (5.4), and Children (5.5). The Self employed, and Employees were examined to see if there were identifiable differences, particularly as they are likely to be doing similar types of work. Children's accidents were examined because they formed the bulk of the third parties killed, and because of the Health of the Nation' White Paper (Department of Health, 1992) target of reducing the death rate for accidents to children aged under 15 by 33%.

Sections 5.6 to 5.8 describe the results relating to three different kinds of accidents, Falls (5.6), Transport (5.7), and accidents where the injury arose from contact with a falling or swinging object (5.8). These were selected because they were the categories containing the largest numbers of fatalities. Finally sections 5.9, 5.10, and 5.11 describe the results obtained when the proximate failure by the deceased fell within the most commonly represented matrix cells. Section 5.9 relates to cell C4 (need to test for danger not recognised whilst operating at the knowledge level), section 5.10 to cell D2 (correct procedure not known, when operating at the rules level), and section 5.11 to cell E1 (response not correctly executed, at the skills level)

The actual data is presented in tabular and graphic form at the end of the Chapter in the same order as the narrative descriptions. Thus:

All victims - Tables A1 to A13, and Figures A1 to A4.

Self employed - Tables B1 to B13, and Figures B1 to B4.

Employees - Tables C1 to C13, and Figures C1 to C4.

Children - Tables D1 to D13, and Figures D1 to D4.

Falls - Tables E1 to E13, and Figures E1 to E4.

Transport - Tables F1 to F13, and Figures F1 to F4.

Struck by - Tables G1 to G13, and Figures G1 to G4.

Matrix cell C4 - Tables H1 to H13, and Figures H1 to H4.

Matrix cell D2 - Tables I1 to I13, and Figures I1 to I4.

Matrix cell E1 - Tables J1 to J13, and Figures J1 to J4.

5.1 Overall review of accidents on farms

Comparison of the two populations

In order to assess how representative the sample three years (1979,1980, and 1988) studied in detail were, of the fatal accidents that have happened over a longer period, the distribution of the values of several of the variables was compared with their distribution among the 939 fatalities that happened from 1/I/79 and 31/XII/92.

Note that in a small number of the cases listed by HSE the value of some of the variables was not recorded. This has resulted in the number of cases for which a value is recorded against a particular variable, being less than 939. This situation arises in Tables 5.1 and most noticeably in Table 5.2 where the site of the injury was recorded in only 926 of the 939 cases.

Age of deceased (Years)	Population (%) N = 938	Non sample victims (%) N = 708	Sample victims (%) N = 230
0 - 5	4.8	4.7	5.2
6 - 10	3.8	3.7	4.3
11 - 15	5.1	3.5	10.0
16 - 19	7.2	7.8	5.7
20 - 24	7.7	8.2	6.1
25 - 29	7.1	7.3	6.5
30 - 34	6.9	7.5	5.2
35 - 39	5.2	5.8	3.5
40 - 44	8.5	8.3	9.1
45 - 49	6.4	6.2	7.0
50 - 54	6.8	6.9	6.5
55 - 59	8.2	8.9	6.1
60 - 64	8.3	8.5	7.8
65 and over	13.8	12.7	17.0

Table 5.1 Age distribution : all years compared with the sample years

The distribution of victims by their ages is shown in Table 5.1. The main difference was the proportion of 11 to 15 year olds killed which was 10% in the sample compared with the model, but made up only 3.5% of the 708 non sample victims. The 65 and over age groups was also over-represented, at 17.0% of the sample victims, compared with 12.7% of the non sample victims. The 6 to 10, 40 to 44 and 45 to 49 age groups were slightly over-represented, whilst the other age groups were under-represented. Almost all of the difference can be accounted for by the excess of 11 to 15 year olds. Eight were expected but there were 23 in the three year sample. In the other eleven years examined there were a further 25 fatalities in this age group. However the Chi-square statistic calculated from the raw data, showed no significant difference between the two populations (χ^2 =18.25, with 13 degrees of freedom, p=0.1484).

It was noted that there was a slightly higher proportion of females in the sample than would have been expected, 9.1% compared with 5.9% in the non sample population.

Part of body	Population (%) N = 926	Non sample victims (%) N = 702	Sample victims (%) N = 230
Whole body	20.8	21.8	20.0
Head	22.6	22.1	22.6
Neck/spine	6.8	6.1	10.9
Ribs/chest/abdomen	25.5	21.7	38.3
Other locations	4.3	4.0	7.0
Several/unspecified	20.0	24.4	1.3

Table 5.2 Distribution of part of body injured : all years compared with sample years.

The distribution of the parts of the body sustaining the injury which led to death, are shown in Table 5.2. The proportion of whole of body and head injuries in the sample and the whole population were remarkably similar. The main feature of this table is the more than 1 in 5 of the non sample victims where the site of injury was not closely specified. Most of these unspecified injury sites appear to have been accounted for by increases in the proportion of injuries to the neck, spine, ribs, chest, or abdomen, as recorded in the three sample years. The Chi-square statistic revealed a result of 64.24 which with 5 degrees of freedom was significant at the 0.001 level.

Accidents which happened on Mondays or Thursdays were very slightly under-represented, in the sample three years. The monthly distribution is displayed in Table 5.3. This shows that the distribution is similar for the sample and non sample years.

Month	Population (%) N = 939	Non sample victims (%) N = 709	Sample victims (%) N = 230
January	7.8	7.2	9.6
February	5.6	5.5	6.1
March	6.5	6.6	6.1
April	8.9	9.7	6.5
May	7.8	6.8	10.9
June	8.8	9.6	6.5
July	12.1	13	9.6
August	11.3	11.1	11.7
September	12.1	11.6	13.9
October	6.8	6.1	9.1
November	6.7	6.9	6.1
December	5.4	5.9	3.9

Table 5.3 Monthly distribution of accidents in the population compared with the sample years.

The differences shown in Table 5.3 are an over-representation in the sample, of accidents that happened in the months of May, September, October and January, and to a lesser extent August. The value of the Chi-square statistic for the monthly distribution of the three sample years compared with that for all of the victims, was 11.64 which with 11 degrees of freedom was not significant ($p=0.3912$). These slight differences are consistent with the higher proportion of child fatalities present in the three years where fatalities were compared with the model. The mean age of the model sample was 40.02 years compared with 40.27 for the larger population. However the standard deviation at 22.48 years was slightly higher than the 21.20 of the larger sample. Again, this is consistent with the slightly higher number of child fatalities present in the sample years.

One variable that it was only possible to consider in the sample, was the length of time between the accident and death. In 180 of the 230 cases death occurred within 24 hours, and usually immediately. Thirtyone victims survived for between 1 and 7 days. Usually these were cases where there was only ever a faint hope of survival, despite intense medical care. There were also a small number of cases in this category where there were delays in certifying brain death. A further eight victims survived for between 8 and 14 days, and 11 more for over 14 days. Taken together these 19 victims who survived for at least a week accounted for 8.3 percent of the 230 cases examined. These cases were almost exclusively older people involved in relatively minor accidents in which they sustained injuries that were not immediately life threatening. e.g. a broken leg. Their age and enforced bed rest during convalescence, led to complications e.g. blood clots, from which they succumbed.

Kind of Accident	Population (%) N = 939	Non sample victims (%) N = 709	Sample victims (%) N = 230
Machinery	13.5	14.2	11.3
Struck by an object	15.2	15.7	13.9
Transport	18	15.2	26.5
Walk into	0.3	0.3	0.4
Slip/trip/fall	1.5	1.3	2.2
Low Fall up to 2m	5.2	3.8	9.6
High Fall >2m	7.9	8.0	7.4
Collapse/overturning	12.7	15.5	3.9
Anoxia/gas/drown	8.3	8.2	8.7
Explosion	3	3.7	0.9
Fire	1.8	1.7	2.2
Electrocution	6.7	7.1	5.7
Animal	5.2	4.5	7.4
Others	0.7	0.8	0

Table 5.4 Distribution by kind of accident : all years compared with sample years.

The distribution of kind of accident in the sample years was compared with that in the 11 other years. Table 5.4 contains a comparison of the proportions found in the two samples. The difference was found to be significant at the 0.001 level when using the Chi-square statistic (value of 41.11 with 16 degrees of freedom, p=0.0005). See Table 5.5.

Kind of Accident	Observed. Sample years N = 230	Actual. All years N = 939	Expected	$\frac{(O-E)^2}{E}$
Machinery	26	127	31.11	0.84
Struck by	32	143	35.03	0.26
Transport	61	169	41.4	**9.28**
Walk into	1	3	0.73	0.1
Handling	0	2	0.49	0.49
Slip/trip/fall	5	14	3.43	0.72
Low fall	22	49	12	**8.33**
High fall >2m	17	74	18.13	0.07
Fall (height unknown)	0	1	0.24	0.24
Collapse/ overturning	9	119	29.15	**13.93**
Anoxia (drowning, gassing)	20	78	19.11	0.04
Exposure to substance	2	28	6.86	3.44
Fire	5	17	4.16	0.17
Explosion	0	1	0.24	0.24
Electrocution	13	63	15.43	0.38
Animal	17	49	12	2.08
Others	0	2	0.49	0.49
Total	**230**	**939**	χ^2 =	**41.11**
df = 16,	Significant at 0.001 level			

Table 5.5 Chi-square statistic. Distribution by kind of accident : all years compared with sample years.

In the case of transport accidents 35 were expected, but 61 observed in the 3 years compared with the model whereas in the 'trapped by something collapsing or overturning' 36 were expected but only 9 observed. In addition in the 'low fall' category 22 were observed, but only 9 expected.

The number of transport accidents in the three years compared with the model was also swollen by a small number of accidents in the earliest two years which had they happened in later years may have been excluded from the statistics on the grounds that they were Road Traffic Accidents. They were included in this analysis in order to maintain consistency with published official statistics. It was also known that the Reporting of Injuries Diseases and Dangerous Occurrences Regulations 1985 (Department of Employment, 1985) were shortly to be amended and that the new regulations (Department of the Environment, 1995) would make more Road Traffic Accidents reportable.

The proportion of accidents that happened on each of the days of the week was very similar in the two populations (See table 5.6). Saturdays were slightly over-represented in the three sample years, but Sunday was under-represented. Overall the samples did not differ significantly (Chi-square statistic = 2.84 at 6 degrees of freedom, p=0.83).

Day	Population (%) N = 939	Non sample victims (%) N = 709	Sample victims (%) N = 230
Sunday	8.7	9.2	7.4
Monday	17.0	17.1	17.0
Tuesday	16.0	16.5	14.3
Wednesday	15.4	15.8	14.3
Thursday	14.9	14.2	17.0
Friday	17.6	17.6	17.4
Saturday	10.3	9.6	12.6

Table 5.6 Distribution of accidents by day of the week : all years compared with the sample years.

The comparison of the distributions of various variables in the sample three years, with their distribution during the remaining 11 years in the 14 year period 1/I/79 to 31/XII/92, has highlighted a number of minor differences. The chief differences being the over-representation of children and old people, and the linked over-representation of certain months. Other differences highlighted anomalies in the coding of accidents by Inspectors. These differences are unlikely to constitute a significant source of error in the main analysis.

5.2 All fatalities.

Published statistics for the years 1979, 1980, and 1988 reveal that there were a total of 230 fatalities in the agricultural, horticultural, forestry and related industries. The antecedents of the accidents which led to these deaths were compared utilising the modified Hale and Glendon accident causation model, as discussed in Chapter 4. For each 'party' involved in the accident, a judgement was made on the available evidence as to the point on the matrix at which that party had failed. The process was repeated as many times as necessary to cover all of the identifiable failures. Each failure was allocated to an area of the matrix, C5, D2, E1 etc.

Figure 5.1 shows the modified Hale and Glendon accident causation matrix. Matrix cells A1, E1, E3, and E7 involved errors that occurred whilst the particular party was operating at the skills level, cells, B6, D2, D3, and D7 were used for rules based errors, and the remaining cells, C3, C4, C5, C6, and C7 related to knowledge based errors.

It was found that eighty nine of the victims were self-employed or family workers, and a further 89 were employees, ranging from directors and managers to basic grade labourers. The remaining 52 deaths were of non employees, primarily children, but also comprising a significant number of adult visitors and others who sustained fatal injuries arising out of work activities.

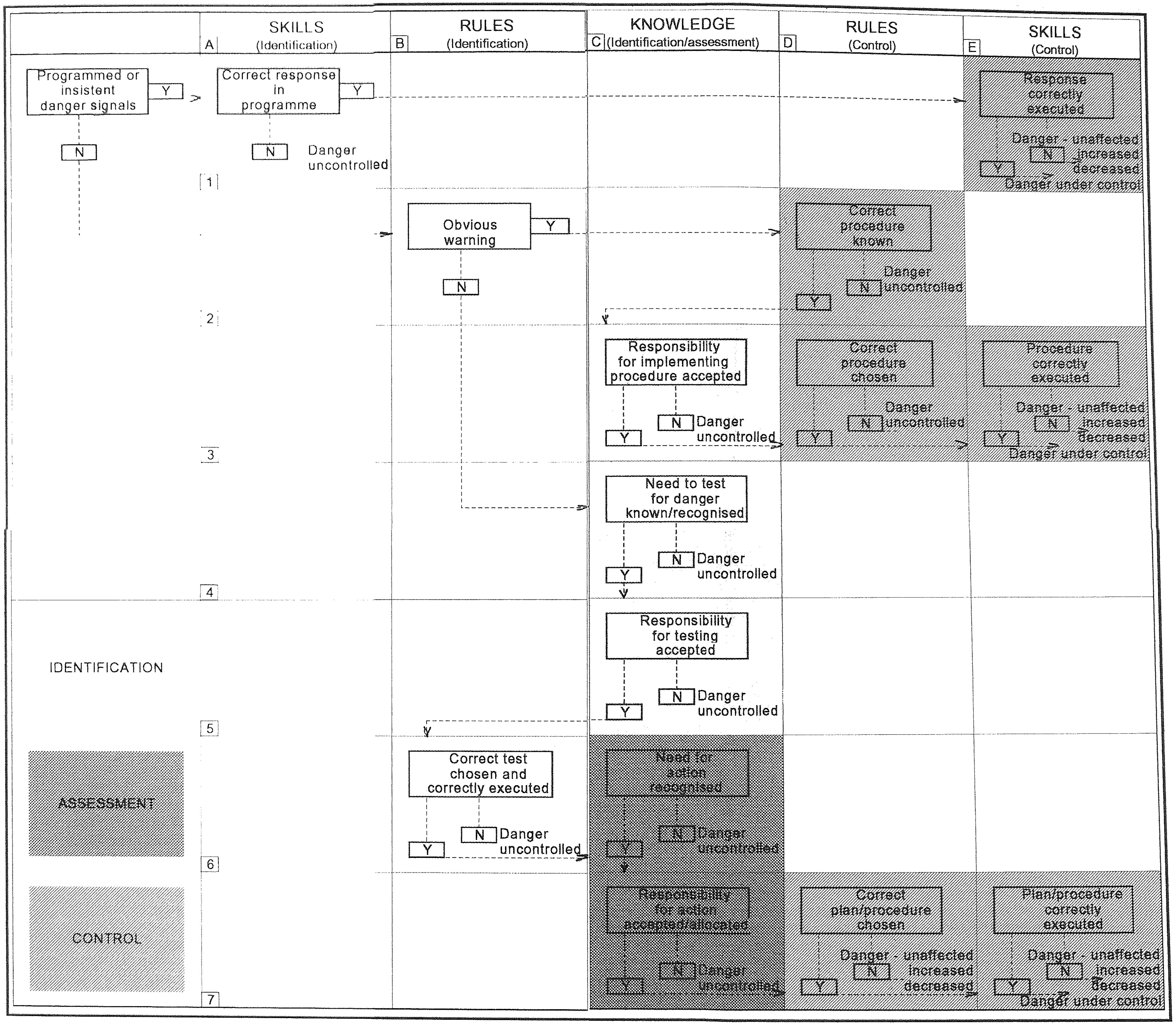


Figure 5.1 Matrix devised from the Hale and Glendon accident causation model.

The initial examination of all 230 cases revealed that the highest proportion of errors that led to the accidents happened whilst the victims were operating at the knowledge level. i.e. at the time of the accident they were primarily involved in non routine 'exploratory' type tasks. (See Table 5.7, and Figure 5.2)

	Victim (proximate)	Victim (distant)	Employer	Machinery owner Land occu'r	Parent	Other-Manuf' supplier/util'y	Colleague
Skills	72	8	10	14	5	5	14
Rules	50	13	20	18	10	4	27
Knowledge	108	32	45	43	19	12	13
Total	230	53	75	75	34	21	54

Table 5.7 Skills, Rules, and Knowledge based errors - absolute numbers

In the case of deceased persons, the next most frequent proximate failures arose whilst practising simple well known everyday skills. The least frequent failure mode, but still relevant in 50 cases (22%) involved the deceased in the faulty application or execution of rules.

An examination was also carried out of what have been termed the 'distant failures', of the deceased. These failures were those which happened, usually at some indeterminate time before the accident, but which contributed to the accident happening, or ensured that it was not prevented. For example, an item of equipment was inadequately maintained over a prolonged period, leading to certain safety devices falling into disrepair. The significance of this was not realised since they were not used or needed until immediately before the accident, whereupon they were found to be inoperative or ineffective. Some of these distant failures may have been repeated a number of times at varying intervals before the accident, but would have only been recorded once. For example the reason for a failure to maintain equipment over a protracted period before the accident, would usually only be recorded as one failure. However if more than one distant failure by the deceased could be identified, then it was recorded.

It was possible to identify instances of distant failures in only about a quarter of the cases (53). This was lower than had been expected, and is probably a reflection of the limitations of the data, particularly the absence of the main witness, the deceased. Moreover it was rarely possible to assess how long before the accident a particular distant failure had occurred. However, the general impression gained was that the distant failures had usually occurred many weeks or months prior to the accident. Often the fact that a failure had occurred was not recognised at the time, or if it was, its significance was underestimated or ignored.

Table 5.7 shows that in 75 (33%) of cases a failure by the employer of the deceased was recorded. In 89 of the 230 cases (39%), there was an employer. Also in a third of cases, there was an identifiable failure by the occupier of land, or owner of machinery or equipment involved in the accident. Given the coding system it is hardly surprising that such failures were generally knowledge based, as can be seen in Figure 5.2.

In almost 15% of cases there was a failure by a parent, or in a few instances a person acting, 'in loco parentis'. In 33% of cases there was an identifiable failure by a colleague, usually one present at the site of the accident. Such colleagues would include for example, fellow employees, self employed people assisting at the site, or adults assisted by aged parents where the parent was killed. 26 of the 76 failures by colleagues present at the time of the accident occurred when following rules, and a further 36 cases involved failures by colleagues when operating at the knowledge level.

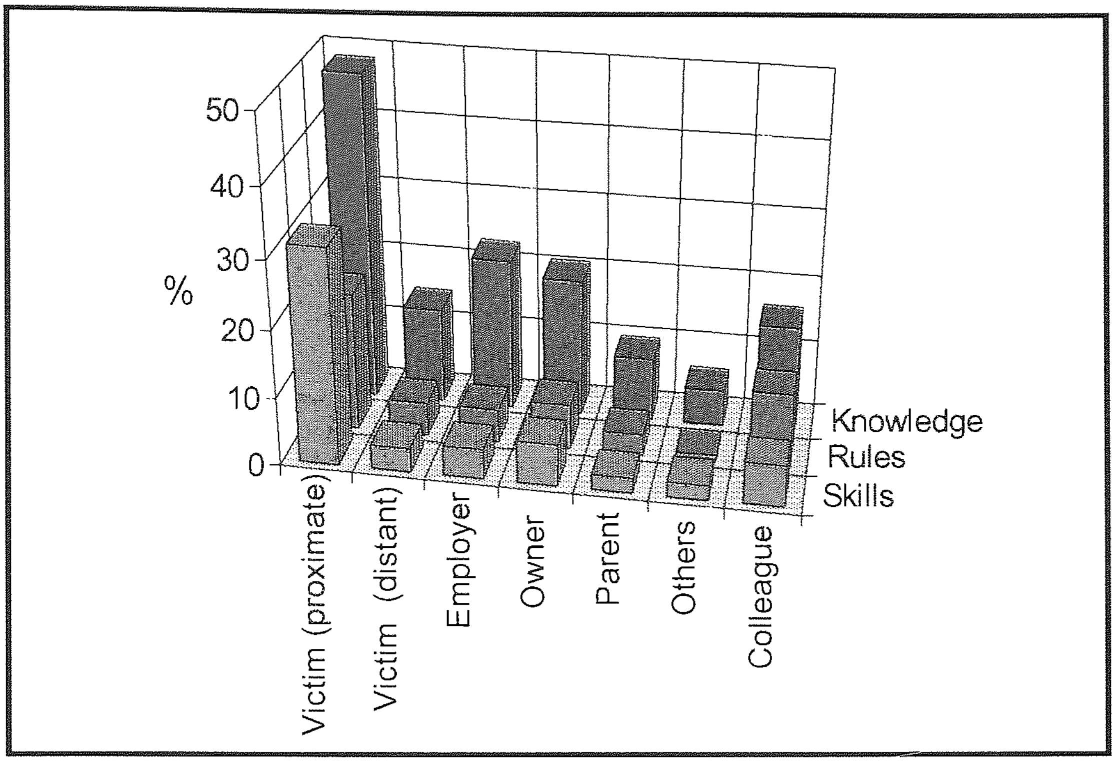


Fig 5.2 Skill, rule, and knowledge based errors - percentages
(Source Figure A.2)

In only slightly over 9% of cases was it possible to identify a failure by another party, which was distant in time and/or space from the locus of the accident. Examples included a very small number of cases where the accident happened because of a design or manufacturing failure, or equipment was installed in a faulty manner. The reason for this may be that where machinery or equipment was implicated it was usually old. Huizinga and Murphy (1989) in a study of farms in Pennsylvania reported that the average age of tractors in use on those farms was 21 years, a finding which is probably not inconsistent with the situation in certain of the less affluent farming areas in this country. Where old machinery is involved in fatal accidents it makes it difficult to separate out the relative contributions of faults arising from design, manufacture, and subsequent (mis)use or lack of maintenance. In many of the cases studied there were no items of machinery or equipment involved in the accident.

A second analysis was carried out to compare the proportions of failures arising from faulty identification or assessment (matrix cells A1, B6, C3, C4, C5, C6, and C7), with failures arising from lack of control (matrix cells D2, D3, D7, E1, E3, and E7). The former was found to be the bigger problem, indeed identification and assessment errors accounted for 55% of the proximate failures by those killed, and 66% of their distant failures. (see Table 5.8).

	Victim (proximate)	Victim (distant)	Employer	Machinery owner Land occu'r	Parent	Other-Manuf' sup'l'r/util'y	Colleague
Identification assessment	127	35	54	46	22	14	37
Control	103	18	21	29	12	7	39
Total	230	53	75	75	34	21	76

Table 5.8 Identification and assessment based errors compared with control problems - absolute numbers

In 75 cases (33%) it was possible to identify a failure by the employer of the deceased. In 54 of these cases the employer failures arose during the identification or assessment of problems. In the other categories of party the proportion of identification and assessment failures compared with control failures was approximately 2 to 1, except in the case of colleagues where the split was roughly 50/50.

A further examination was carried out in which the proportion of failures arising from (a) lack of skill (matrix cells A1, E1, E3, and E7), (b) the faulty application of rules (matrix cell D2), (c) errors arising from lack of knowledge (matrix cells C4 and C6), and (d) violations where the correct course of action was known (matrix cells C3, C5 and C7) together with cells (B6, D3, and D7) which most probably involved violations .

	Victim (proximate)	Victim (distant)	Employer	Machinery owner Land occu'r	Parent	Other-Manuf' supplier/util'y	Colleague
Skills	72	8	10	14	5	5	14
Rules - errors	37	6	2	10	4	0	19
Knowledge - errors	62	8	32	17	6	6	22
Violations	59	31	31	34	19	10	21
Total	230	53	75	75	34	21	76

Table 5.9 Skills, rules, and knowledge based errors compared with violations - absolute numbers

Overall, violations were found to account for a similar or larger proportion of errors than the other three types of failure. This was particularly true for distant failures by the deceased, employers, the owners of land or machinery involved, parents, and for others.

5.3 The self employed

The sample of 230 accidents subjected to detailed examination against the accident causation model, included 89 cases where the deceased was self employed. All but 12 worked full time in the industry. The age distribution appears unusual in that whilst in most of the age bands there are between 4 and 8 victims, 15 of those killed were aged between 40 and 44 years.

85 of the 89 victims were male and in only 22 cases did the deceased survive longer than 24 hours. At 27 cases, transport was the most frequently cited kind of accident, followed by 12 in which the deceased was struck by something, and 11 cases involving machinery. The distribution by month appeared to reflect the distribution of work, with peaks in May (11), July (10), and September (11). Unusually there were also 10 self employed people killed in January, which appears high when compared with December (3), February (4) and March (4).

The distribution of accidents by day of the week shows three days on each of which there were 16 accidents, Wednesday, Thursday, and surprisingly, Saturday. Taken with Sundays total of 7, this meant that 23, or 25.8% of accidents to the self employed happened at weekends.

When examined against the accident causation model, it was found that the most frequent proximate failures by the deceased were whilst operating at the knowledge level. (See Table 5.10)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner Land occu'r	Parent	Other-Manuf' supplier/util'y	Colleague
Skills	20	5	0	3	0	2	4
Rules	22	5	1	5	0	0	13
Knowledge	47	19	0	9	3	7	15
Total	89	29	1	17	3	9	32

Table 5.10 Self employed people - Skill, rule, and knowledge based errors - absolute numbers

Table 5.10 shows that twenty (22%) of the 89 self employed victims were operating at the skills level when the accident happened. The most common problem being a failure to correctly execute a known response. e.g. failure to flee sufficiently swiftly from a bull.

Of the 22 accidents to self employed people who were working at the rules level, almost all (19) of the proximate failures involved situations where a known correct procedure was not adopted. In a further 4 cases there had been a distant failure involving the non adoption of a known procedure. There were 13 cases where a failure by a colleague could be identified, 10 where the correct procedure was known but not adopted.

However the majority, 53% of proximate failures by deceased self employed people occurred whilst operating at the knowledge level. In a further 19 (20%) cases a distant failure, usually involving non acceptance of responsibility (cell C3 on the matrix), was identified. In 17% of those cases where the deceased was operating at the knowledge level there were failures identified involving one or more colleagues.

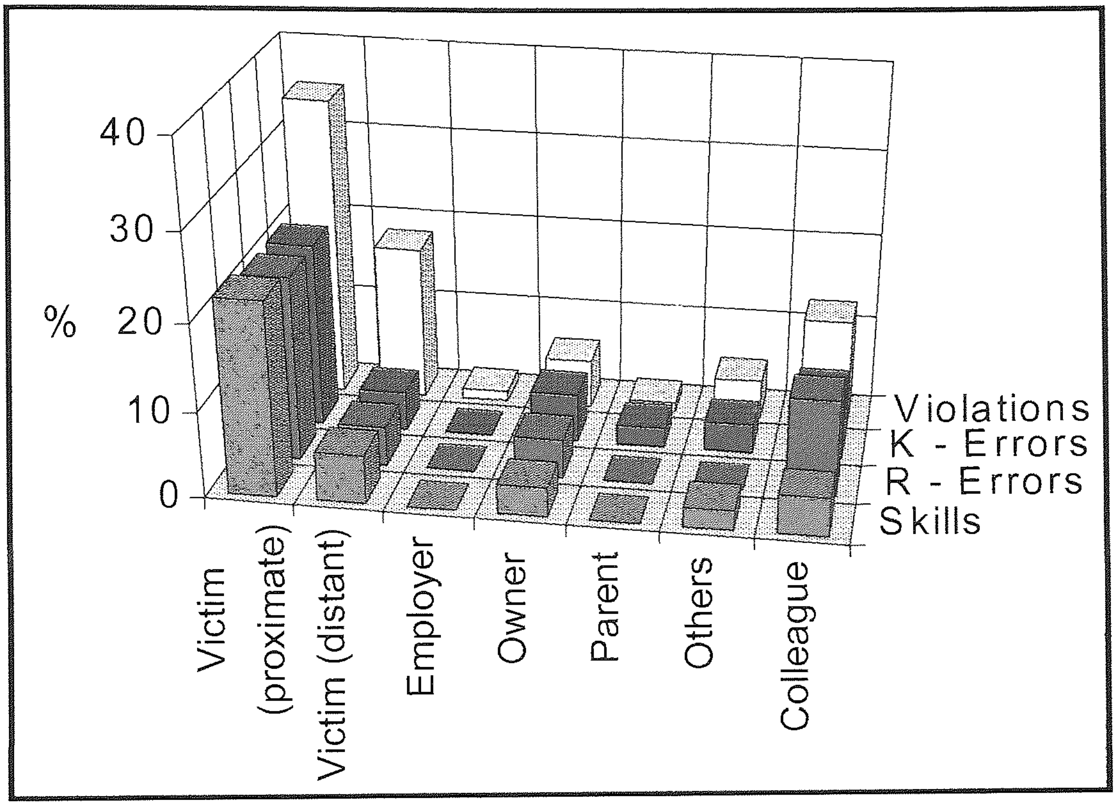


Figure 5.3. Self employed victims - Comparison of skill, rule and knowledge based errors, with violations, as percentages

(Source Figure B.4)

Figure 5.3 shows that for accidents involving the self employed, violations accounted for almost 35% of proximate failures, and 18% of distant failures. For employees the corresponding figures were 25% and 15%, suggesting a greater tendency on the part of the self-employed to take inappropriate risks whilst operating at the knowledge level in situations where they did know or could reasonably have been expected to have known the correct procedure. It has previously been noted that there may have been a slightly increased tendency on the part of investigating

Inspectors, to attribute violations to self-employed victims, compared with victims who were employees.

To summarise : Over 50% of failures by self employed people occurred at the knowledge level; almost 75% involved control rather than Identification or Assessment failures; nearly 35% of cases involved them in violations of known rules or procedures.

5.4 Employees

The sample of 230 accidents examined in detail against the accident causation model, contained 89 cases where the deceased was an employee, 76 of whom were full time. The age distribution shows a peak in the early years, declining to a minimum in the 30's and early 40's then rising to peaks at 50-54 and 60-64. See Figure 5.4.

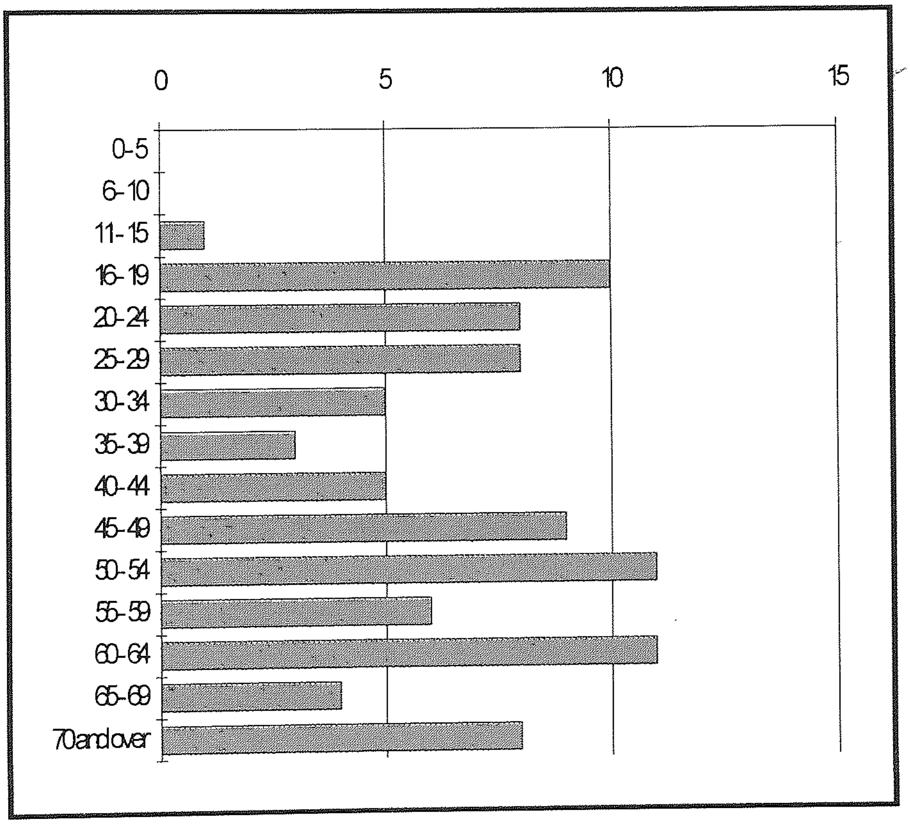


Figure 5.4 Age distribution of employees - absolute numbers

(Source Figure C.1)

83 of the 89 victims were male and in 23 cases the deceased survived for more than 24 hours. At 21 cases, transport was the most

frequently cited kind of accident, followed by 16 in which the deceased was struck by a falling or swinging object. Ten accidents involved contact with moving machinery, and a further 10 were high falls. The distribution by month shows a peak in the autumn (13 in August, 12 in September, and 8 in October). In addition there were 9 fatalities in May. However there were

also 10 people killed in January, and 8 in February, which appears high when compared with December (4), and March (5). This distribution is however similar to that found for self employed people.

In the case of accidents to employees, the most common proximate failures by the deceased occurred whilst practising a skill, usually arising from a failure to effect an escape. (See Table 5.11)

	Victim (proximate)	Victim (distant)	Employer	Machinery owner Land occu'r	Parent	Other-Manuf' supplier/util'y	Colleague
Skills	35	2	10	3	0	3	7
Rules	20	7	17	3	0	3	9
Knowledge	34	12	42	8	0	4	13
Total	89	21	69	14	0	10	29

Table 5.11 Employees - Skill, rule, and knowledge based errors - absolute numbers

However there were almost as many fatalities arising from proximate errors whilst the victim was working at the knowledge level, as there were at the skills level. This ratio is markedly different to that found for victims who were self employed.

In 69 of the 89 cases it was possible to identify an error by the employer of the deceased. The vast majority of these errors arose whilst the employers were operating at the knowledge level, indicating that they either didn't know something or failed to act upon information which they could reasonably have been expected to know.

There were 29 cases in which an error by a colleague, usually someone present at the site of the accident, could be identified. Thirteen of these 29 cases involved knowledge based errors.

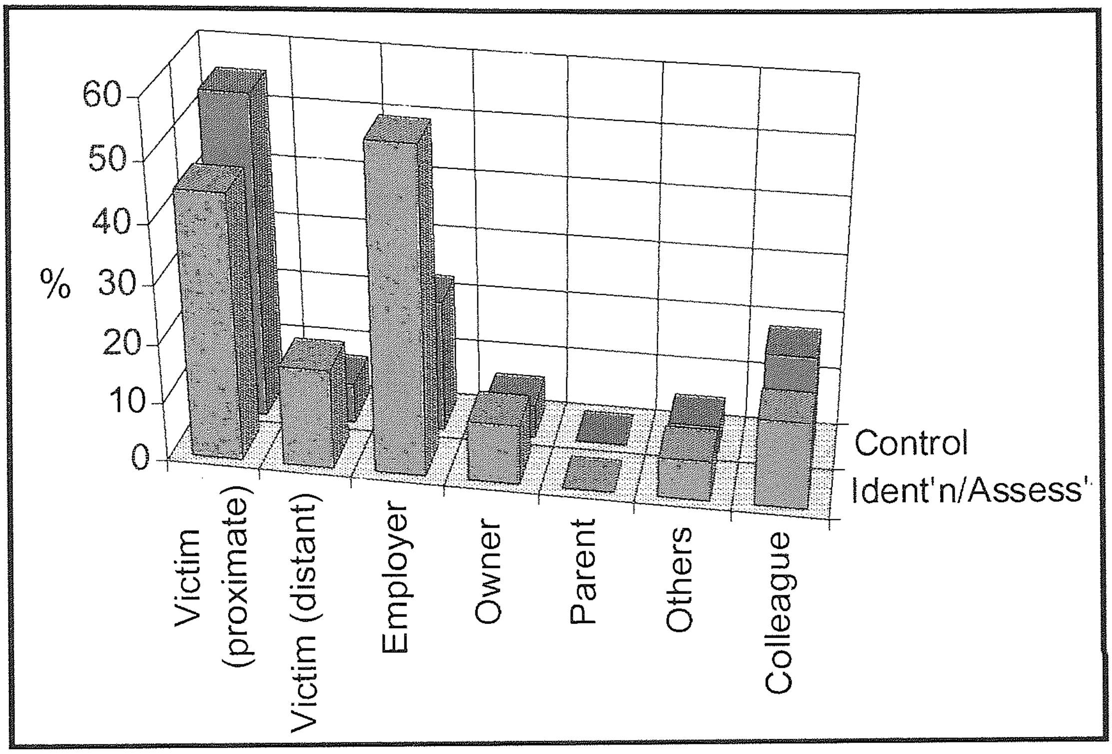


Figure 5.5 Comparison of Identification/assessment with control failures for employees - percentages

(Source Figure C.3)

The identified errors were also categorised into control, and identification and assessment errors. The results of this analysis are shown in Figure 5.5, and indicate that whilst for proximate failures there are slightly more control errors, this is not the case for distant failures. The vast majority of employer failures involved errors arising from identification and assessment.

Table 5.12 shows that in only about a quarter of the cases do the errors arise from a violation of known rules or procedures. However in the case of errors by employers resulting in the death of their employees, 30 arose from errors whilst operating at the knowledge level, whilst 27 involved violations of rules or known procedures.

	Victim (proximate)	Victim (distant)	Employer	Machinery owner Land occu'r	Parent	Other-Manuf' supplier/util'y	Colleague
Skills	35	2	10	3	0	3	7
Rules - errors	12	2	2	1	0	0	5
Knowledge - errors	20	4	30	3	0	3	10
Violations	22	13	27	7	0	4	7
Total	89	21	69	14	0	10	29

Table 5.12 Employees - Skills, rules, and knowledge based errors compared with violations - absolute numbers

5.5 Children aged 0 to 15

The sample of 230 cases compared against the accident causation model contained 45 children (19.6%), the youngest being 1 year old. Four of the children were 'at work' at the time of their accidents.

There were twelve children aged under 6, ten aged 6 to 10, and 23 aged 11 to 15 inclusive. (See Table 5.13)

Ages	Sample victims n=230 (%)	Non sample victims n=708 (%)
0 - 5	12 (5.22)	33 (4.66)
6 - 10	10 (4.35)	26 (3.67)
11 - 15	23 (10.00)	25 (3.53)
Total	45 (19.57)	84 (11.85)

Table 5.13 Proportion of Children killed - sample years compared with non sample years

In the 14 year period 1979 - 92 inclusive there were 129 children killed, 45 in the three sample years, and 84 in the remaining 11 non sample years. There were thus many more child fatalities than would have been expected. Had the proportions in the sample and non sample years been the same, only 27 child fatalities would have been expected in the three sample years. The three years selected (1979,1980, and 1988), happened to contain more than the usual number of child fatalities, the annual distribution of which is shown in greater detail in Table 5.14.

Year	Number of Child fatalities
1979	**24**
1980	**10**
1981	13
1982	13
1983	5
1984	4
1985	10
1986	9
1987	8
1988	**11**
1989	5
1990	8
1991	2
1992	7
Total	129

Table 5.14 Numbers of Children killed - 1979 -1992

Of the forty-five child victims in the three sample years, 35 were male, and 10 (22.22%) were female. A small number (5) of the children were classed as being casually employed. The remaining 40 children were merely present on farms or at sites where work activities were taking place, where they were observing or assisting but without being formally employed.

Over half of the children (23 of 45) were aged 11 to 15, a proportion that has already been noted (at section 5.1) as being much higher than expected. Were the child fatalities to be spread evenly throughout the year, approximately 4 would be expected each month. In practice there were found to be considerable variations in the monthly distribution of child fatalities in the three sample years, with peaks of 8 in September, 6 in August, and 5 each in April and May.

The main kinds of accident in which children were killed involved transport (hit by a moving vehicle), 13 cases, drowning or asphyxiation 10 cases, and low falls 8 cases. The main body parts affected were ribs/chest, head, and whole body.

In over 50% of the child fatalities the child was operating at the knowledge level when the accident happened. Over 75% of the child fatalities involved failures by them to correctly identify or assess the hazard, as can be seen in Figure 5.6. Figure 5.6 also demonstrates a high level of identification/ assessment failures by parents, and by owners of land or machinery which may have been involved in the accident.

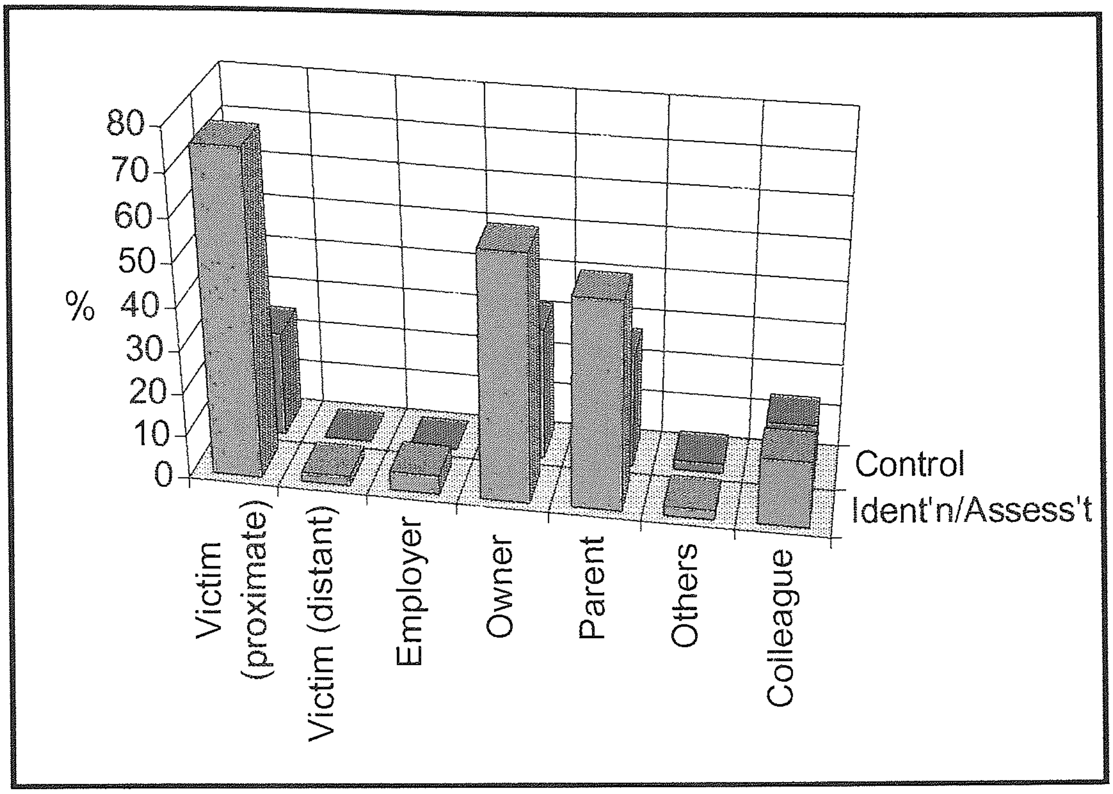


Figure 5.6 Comparison of Identification/assessment with control failures for children - percentages (Source Figure D.3)

Further tests were carried out to assess the extent to which the accidents to children involved a lack of skill, knowledge or rule based errors, or violations. The results at Figure 5.7 show a large proportion of violations by parents and owners of machinery or land, together with a high level of knowledge based errors on the part of the children involved.

5.6 Falls from heights

Thirty nine fatalities resulted from falls from height. Twenty two were low falls, the remaining 17 being classed as high falls (over 2m). Thirty four of the victims were male and five female. Thirteen of those killed were classed as self employed or family workers, eight being non-employees (all children). The remaining eighteen (46%) were employed persons. Six of the victims were aged from 60 to 64, and eight were 70 or over. Thus over 56% of those killed by falls were either children

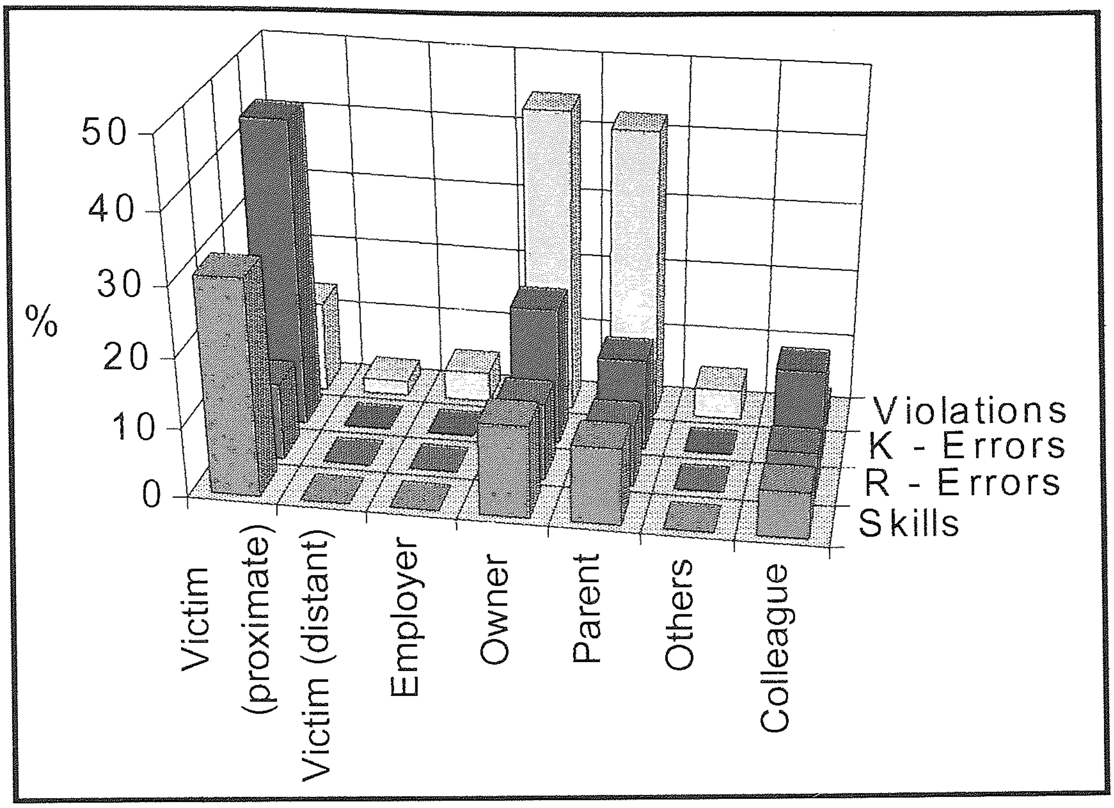


Figure 5.7 Skill rule and knowledge based errors vs. violations for children - percentages

(Source Figure D.4)

or old people. The monthly distribution shows peaks of 6 in January and October, 5 in August, and 4 in July and September. In 18 cases the deceased succumbed to head injuries. An unusually high proportion of the victims survived for longer than 24 hrs. Fifty-one percent compared with only 22% in the whole sample of 230 studied.

A total of 47 failures (39 proximate and 8 distant) by the 39 deceased persons were identified. The distribution of those failures was fairly evenly spread between the skills, rules and knowledge categories, as is shown in Figure 5.8.

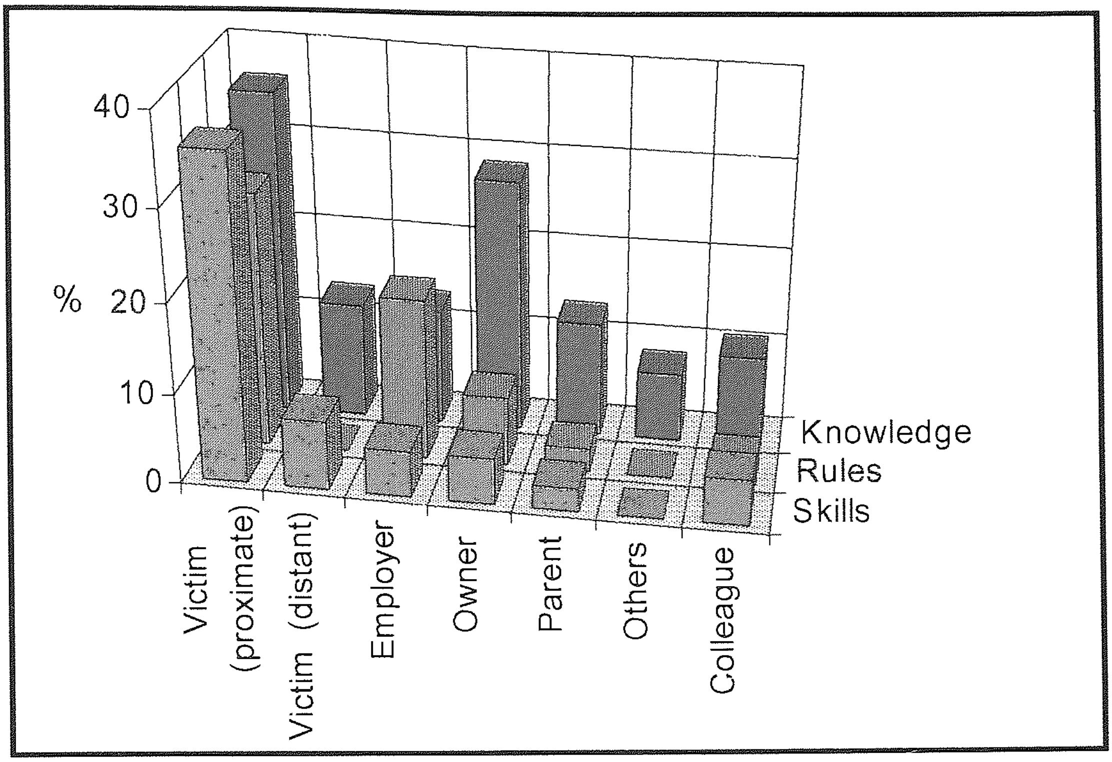


Figure 5.8 Skill rule and knowledge based errors for falls - percentages
(from Figure E.2)

The extent to which violations of known practices and procedures were implicated in accidents categorised as falls, is illustrated in Figure 5.9. The striking feature of Figure 5.9 is the high proportion of violations identified. The proportion of knowledge and rules based errors, and errors arising from lack of skill, was small in comparison to the number of violations identified. Not only were there many more distant violations committed by the victims, but there were also more violations by every other category of party examined.

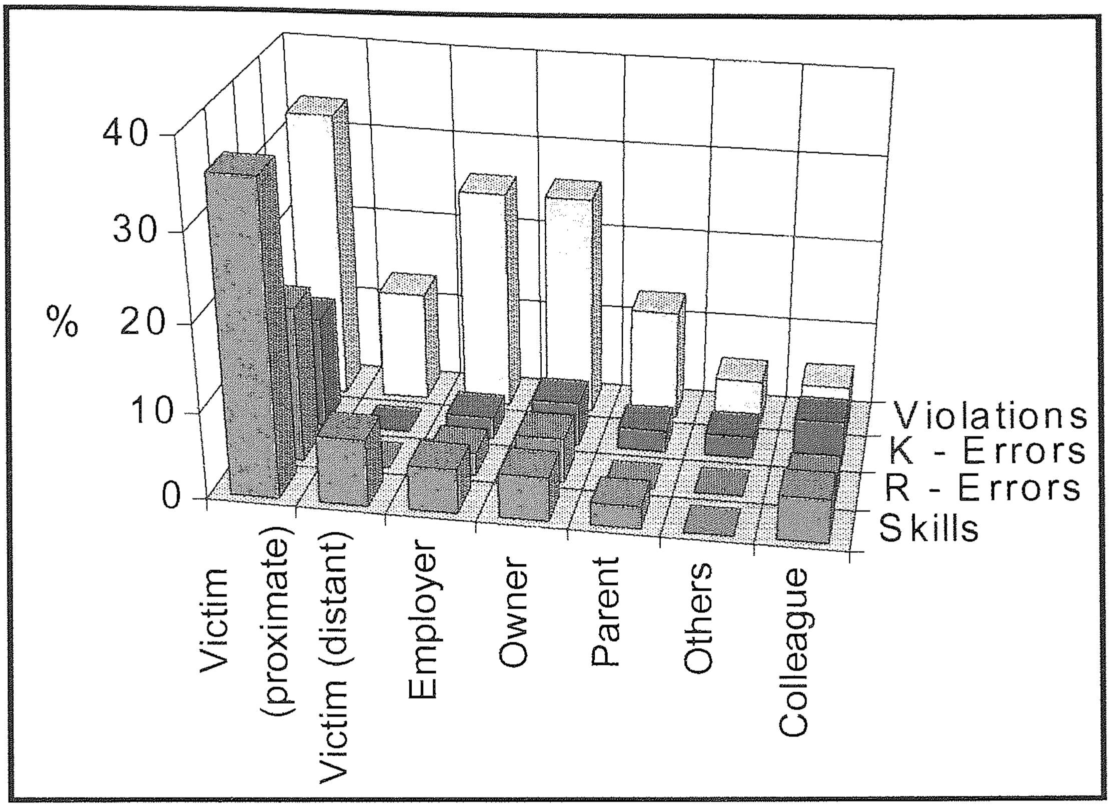


Figure 5.9 Skill, rule and knowledge based errors and violations, for falls - percentages

(Source Figure E4)

5.7 Transport accidents

It has already been noted in section 5.2 that the proportion of Transport accidents was higher than expected. Sixty-one of the 230 accidents (27%) involved the deceased being struck by a moving vehicle. Slightly more self-employed and family workers, than employees were killed, 27 to 21. Thirteen of the victims were children, and a further 14 were aged 60 or more. The peak months for transport accidents were August with 10, September with 9, and May with 7. The distribution of parts of the body suffering the main injury was similar to the distribution in the whole sample, although there were slightly more abdominal injuries than expected.

The breakdown of the accidents into skill, rule and knowledge based errors shows that in almost 50% of cases the proximate error by the deceased involved an error whilst operating at the skills level. (see Figure 5.10)

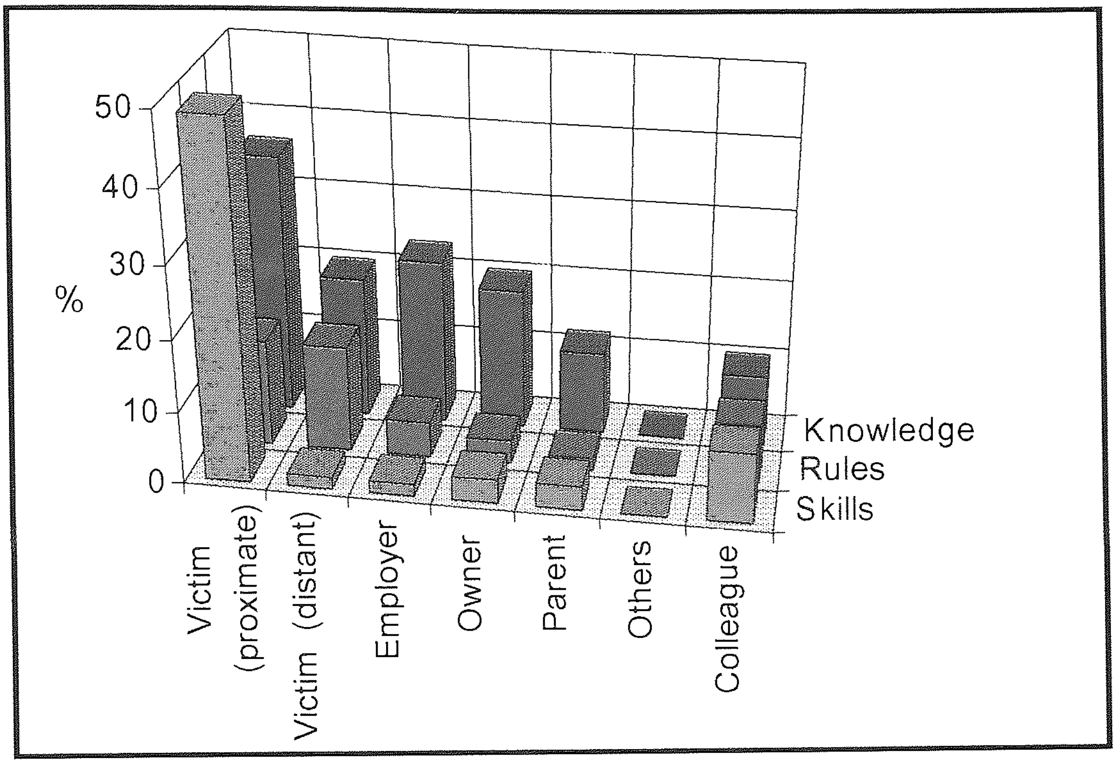


Figure 5.10 Skill, rule and knowledge based errors for transport accidents - percentages

(Source Figure F2)

In 36% of cases the proximate failure arose whilst operating at the knowledge level. In only 14.8% of cases did the deceased's proximate failure occur whilst operating at the rules level, exactly the same proportion as for distant failures. Figure 5.10 also shows that failures by other parties connected with the accidents were more likely to be at the knowledge level of operation, and that in over a quarter of cases there was an error by a colleague present at the time of the accident. Failures by other parties usually involved the incorrect identification or assessment of the hazardous situation. When violations were examined it was found that in 23% of cases the victim's proximate failure was a violation, and in a further 23% the distant failure also involved a violation. (see Figure 5.11)

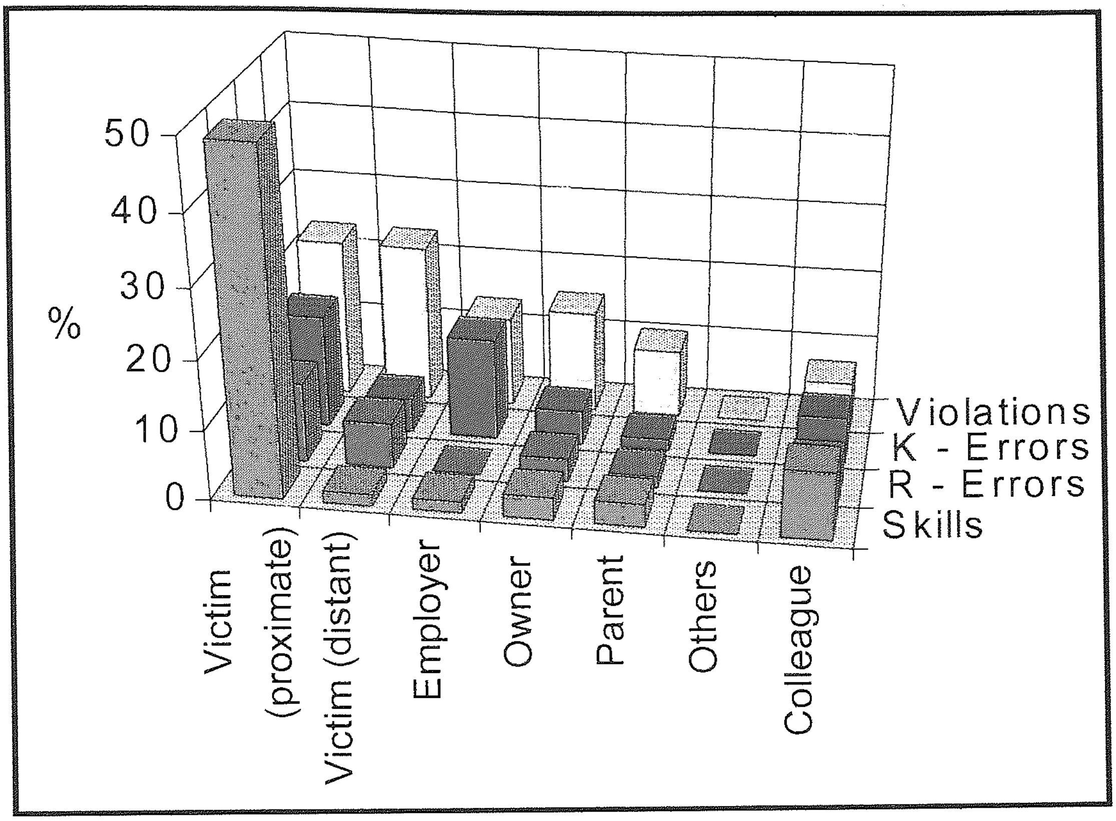


Figure 5.11 Skill, rule and knowledge based errors, and violations, for transport accidents - percentages

(Source Figure F4)

5.8 Contact with a falling or swinging object

This category includes accidents where the deceased was struck by a moving object. This includes flying or falling objects, but excludes accidents where the deceased was struck by a vehicle under power.

Of the 32 accidents in this category, 50% happened to employees, all but one of whom were full-time. The remaining 16 included 12 self-employed people, and 4 non-employees, all children. A striking feature of this group of accidents is the age distribution where 15 of the victims were in the age range 40 to 54 inclusive. (see Figure 5.12)

The monthly distribution of the accidents shows that they happened in the winter and spring rather than in the summer months. There were 5 in November, 6 in January, 4 in February, and 3 in each of March, April and May. Twenty-six of the victims (81%) suffered injuries to the head , or chest area, a much higher proportion than the 56% found in the main sample of 230.

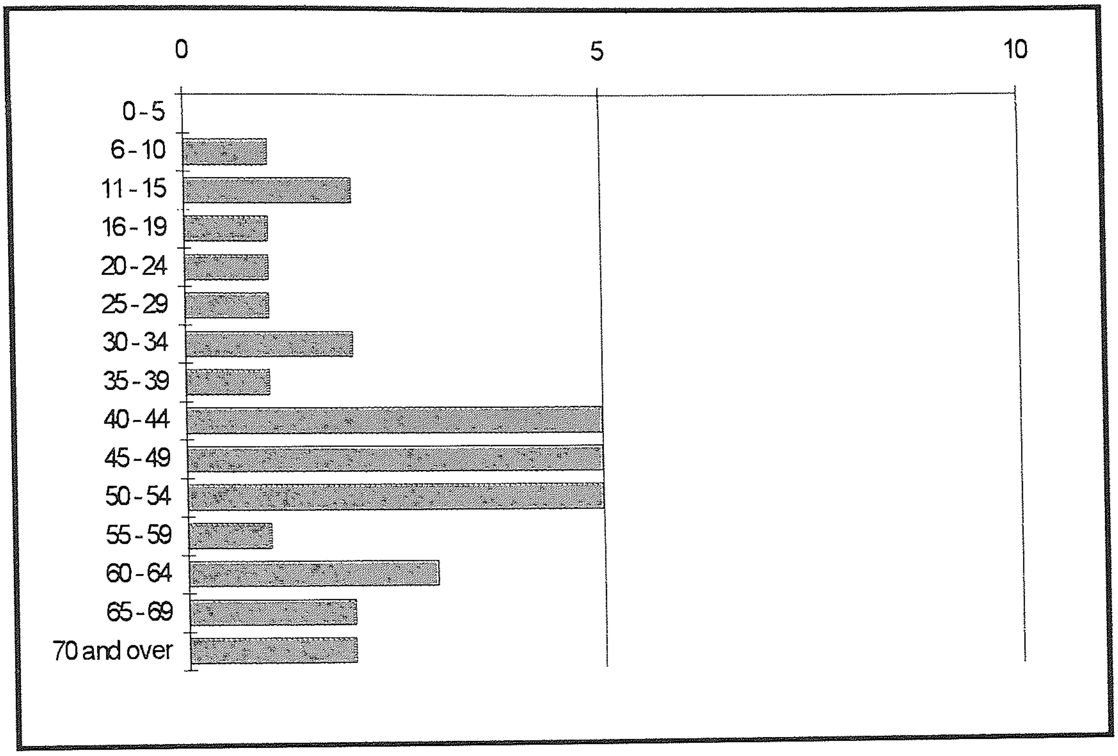


Figure 5.12 Age distribution - Accidents involving contact with a falling or swinging object - numbers

(Source Figure G 1)

When compared against the accident causation model, it was found that errors whilst operating at the knowledge level were predominant in the case of proximate and distant failures by the deceased, and failures by employers and colleagues present at the time of the accident. Put simply this means that those involved either failed to actively seek out hazards, or having identified a hazard, failed to accept responsibility for doing something about it. In 37.5% of cases there was a failure by the deceased whilst operating at the rules level, and in 22% of cases there was a similar failure by a colleague.

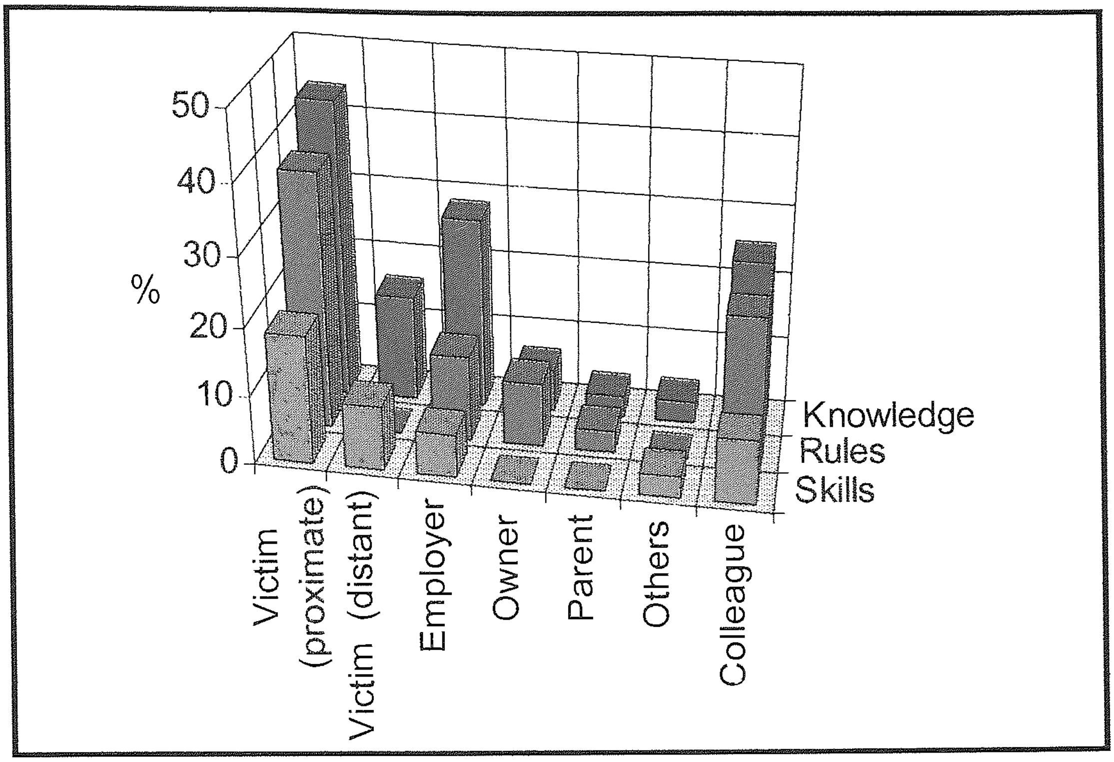


Figure 5.13 Skill rule and knowledge based errors for accidents involving contact with a falling or swinging object - percentages

(Source Figure G 2)

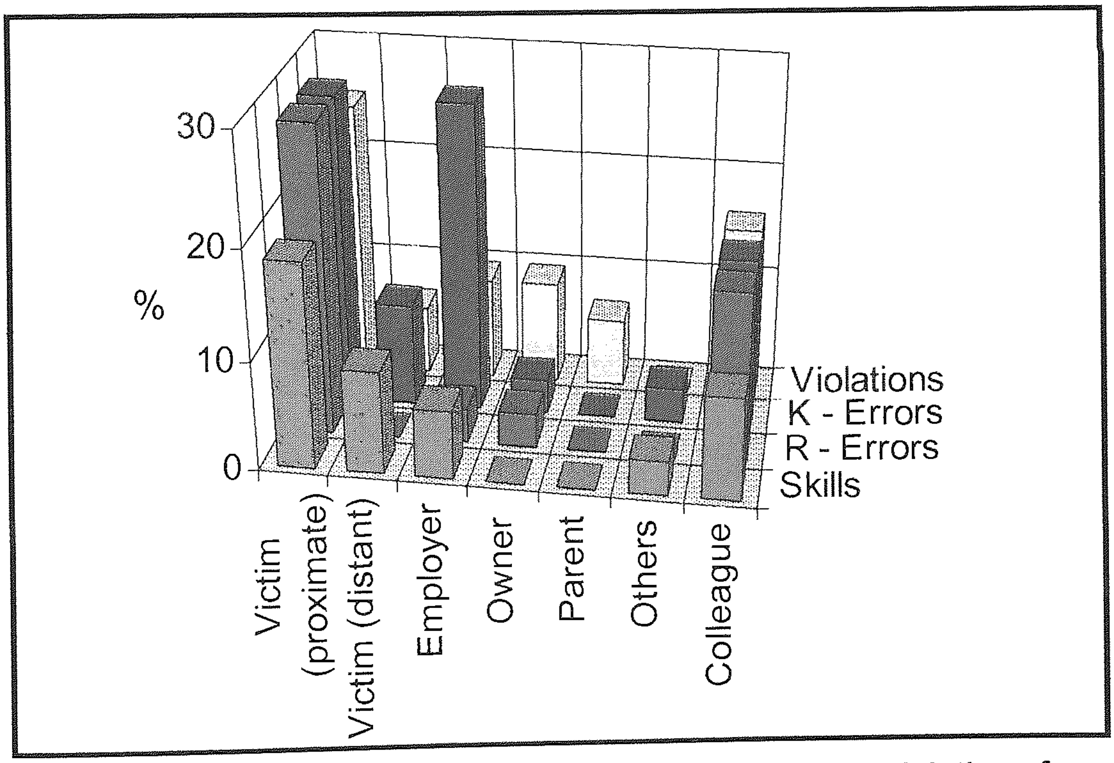


Figure 5.14 Skill rule and knowledge based errors, and violations for accidents involving contact with a falling or swinging object - percentages

(Source Figure G 4)

Figure 5.14 shows the distribution of skill, rule and knowledge based errors, and violation for accidents where the victim was struck by a falling or swinging object. The proximate failures by the deceaseds are fairly evenly spread among the four categories. There were 9 cases where there was a knowledge based error by the deceaseds employer, which is striking when one remembers that only 16 of those killed actually had an employer, the rest being self-employed, or children.

5.9 Matrix cell C4 (need to test for danger not recognised)

Matrix cell C4 identifies errors which occurred where the danger was not obvious and the deceased or some other party, or both, failed to recognised the presence of the danger. This may have been because they were unaware that the signs which were present, indicated a danger, or because they simply did not think to look out for that danger.

There were 59 cases in which the proximate failure of the victim was allocated to cell C4 on the matrix. Twenty-three of the victims were non-employees, 19 were self-employed or family members, and 17 were employees. A third of the victims were under 16 years old, and very few people aged from 20 to 39 were killed. The distribution of accidents was fairly even throughout the year, with slightly more having happened in April (9), May (8), and September (9). The most frequent kinds of accidents identified were 11 cases of drowning or asphyxiation, 10 cases of victims being hit by moving vehicles, and 9 where the victim was struck by a falling or swinging object. The findings in relation to the part of body injured were fairly consistent with the findings for the whole sample except that whole of body injuries were slightly more common.

The examination of other failures associated with the 59 where the proximate failure was coded as C4 revealed only 5 cases (8.5%) where it was also possible to identify a distant failure by the deceased. As has previously been noted there were 53 distant failures in the sample of 230 accidents (23%).

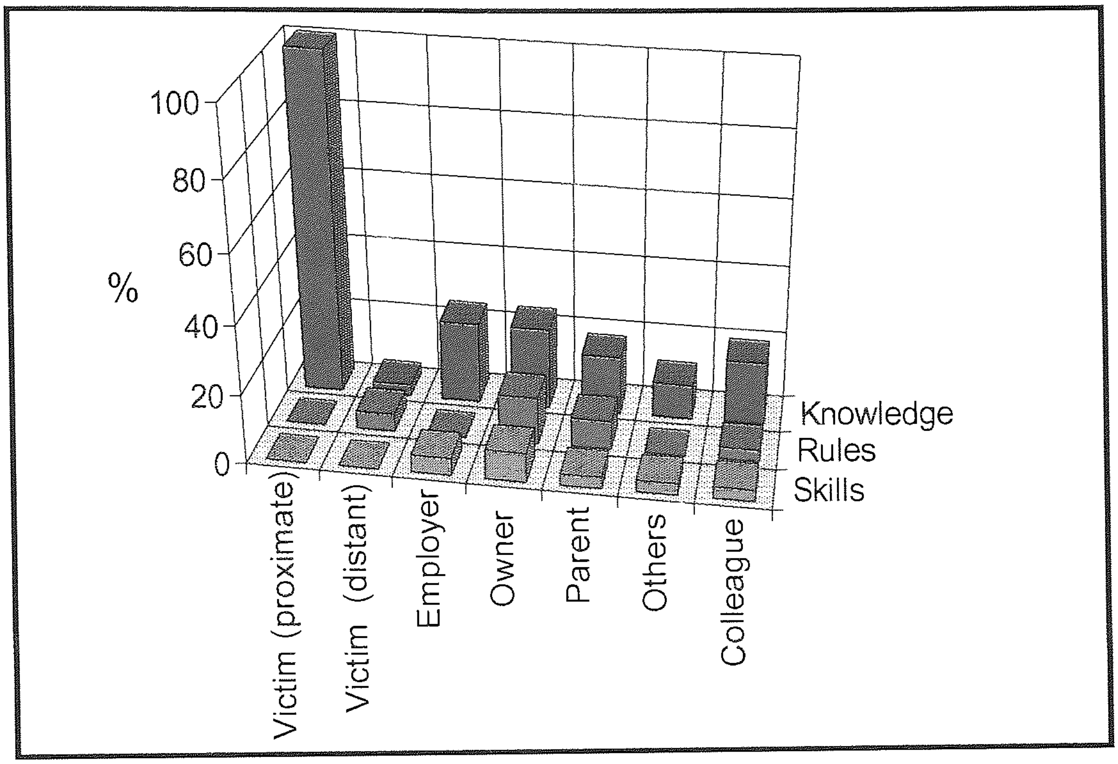


Figure 5.15 Skill rule and knowledge based errors, where the proximate failure was C4 - percentages

(Source Figure H 2)

Figure 5.15 shows the percentages of skill, rule and knowledge based errors that also occurred when the proximate error was classified as C4. As can be seen most of these other failures happened whilst the parties making them were operating at the knowledge level.

The failures by parents and by owners of land were primarily located at cell C3 which indicates that they failed to accept responsibility for dealing with an obvious danger. Ten of the failures allocated to employers happened at cell C4 indicating that they were as ignorant of the presence of the hazard, or the need to hazard spot, as were the victims. It has already been mentioned that only 17 of the victims in this group were employees.

Errors made by parents or by owners of land and machinery, were primarily violations, whereas employers tended to make errors whilst operating at the knowledge level.

5.10 Matrix cell D2 (correct procedure not known)

Matrix cell D2 was the most frequently cited area of the matrix, when the proximate failure by the deceased occurred whilst operating at the rules level. Specifically the cell describes those errors where there was an obvious warning but the deceased was unaware of the correct procedure to adopt in dealing with it.

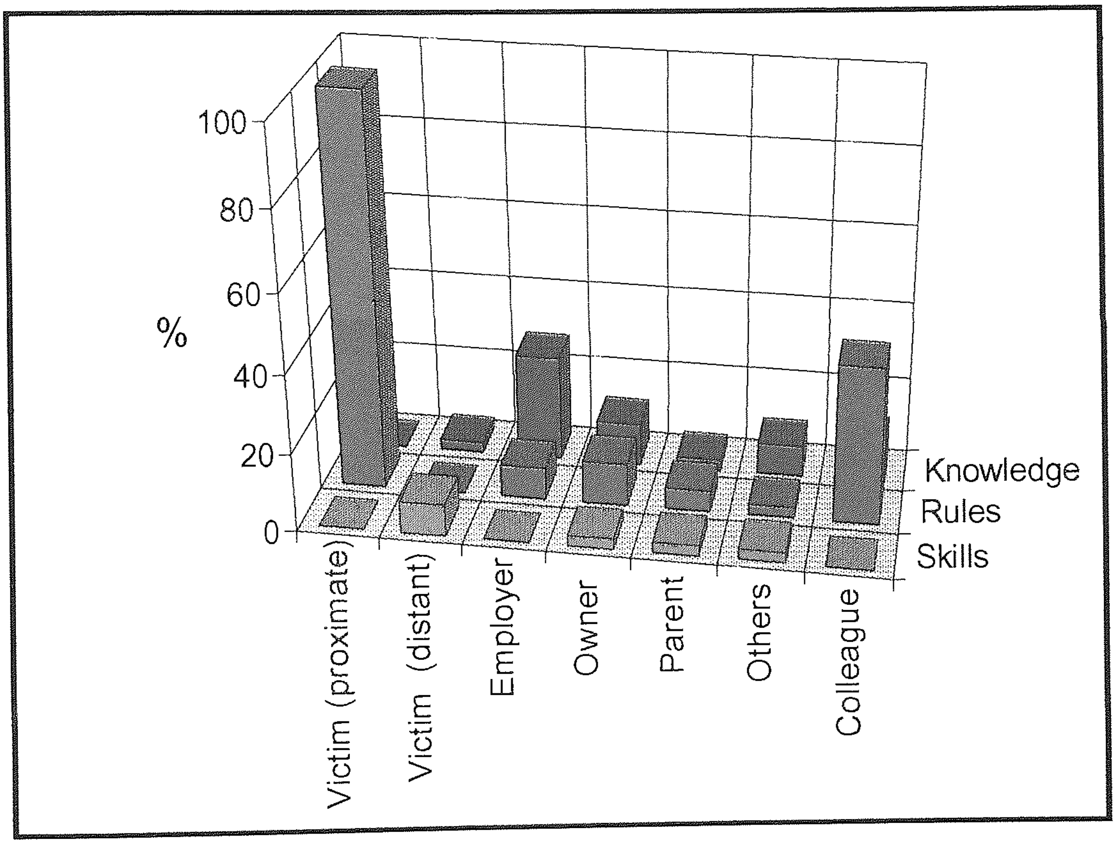


Figure 5.16 Skill rule and knowledge based errors, where the proximate failure was D2 - percentages

(Source Figure I 2)

Nineteen of the 37 cases where the proximate failure by the deceased was coded D2, involved self-employed or family workers. There were 6 non-employees, the remaining 12 victims being employees. In 10 cases there was a knowledge based failure by the employer of the deceased, which is a relatively high proportion considering that there were only 12 employee victims in this category. (see Figure 5.16)

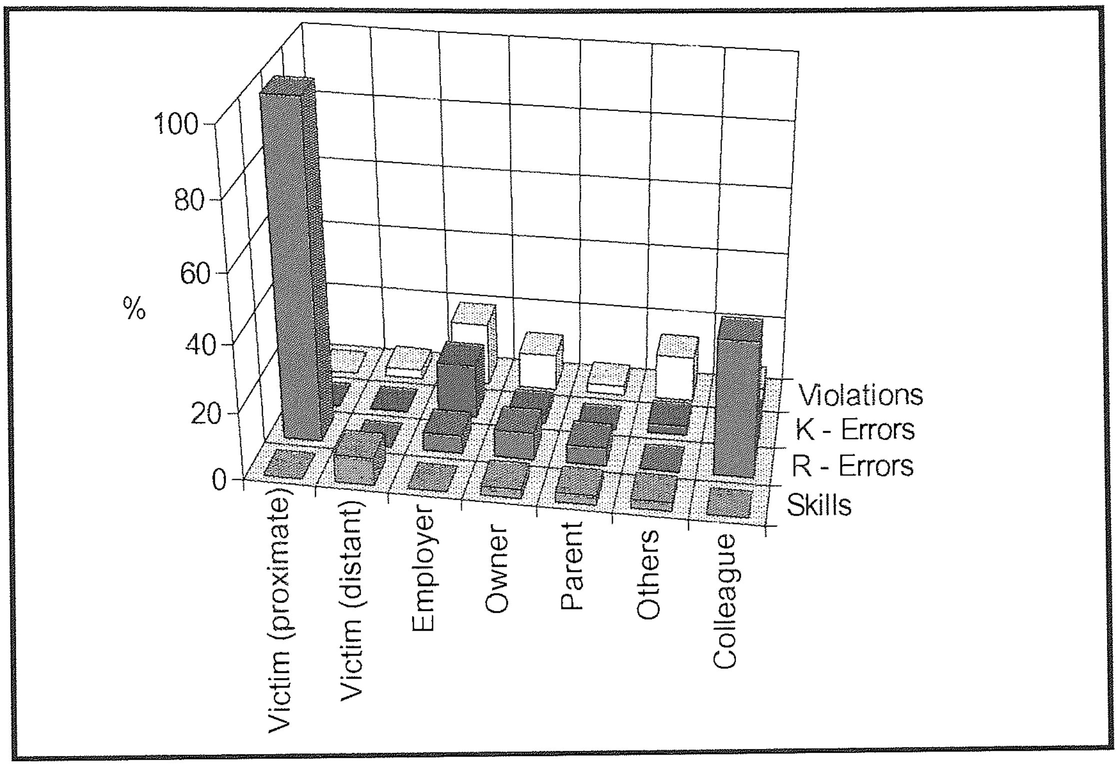


Figure 5.17 Skill rule and knowledge based errors, and violations where the proximate failure was D2 - percentages

(Source Figure I 4)

The comparison of skills, rules and knowledge based errors, with violations shows that in just over 40% of cases it was possible to identify a failure to apply known rules, on the part of a colleague of the deceased person. All of the rule based errors by colleagues were also coded D2.

5.11 Matrix cell E1 (response not correctly executed)

The most frequently cited kind of error where the deceased was operating at the skills level when the accident occurred, was coded cell E1. Cell E1 refers to the situation in which the danger signal is so obvious and insistent that one automatically attempts to escape, yet the deceased failed to make good their escape. There were 38 such accidents. Of these 13 involved self-employed or family members, 7 were to non-employees (only 2 of whom were children), and 18 to employees. Only three of the victims were aged under 20, eleven were aged from 20 to 34, and 14 of the victims were aged 60 or more. The most frequent months for such accidents were July, August and October, with 6 each. Almost 40% of the accidents involved the victim being hit by a moving vehicle.

When examined against the accident causation matrix it was noted that in almost 66% of cases there was an earlier, distant failure by the deceased. This is a surprisingly high figure when as has previously been shown, the proportion for the whole sample was only 23%.

Figure 5.18 shows the relative proportions of skill, rule and knowledge based errors, where the proximate failure of the deceased was E1, a failure to successfully execute an automatic response to an insistent danger signal.

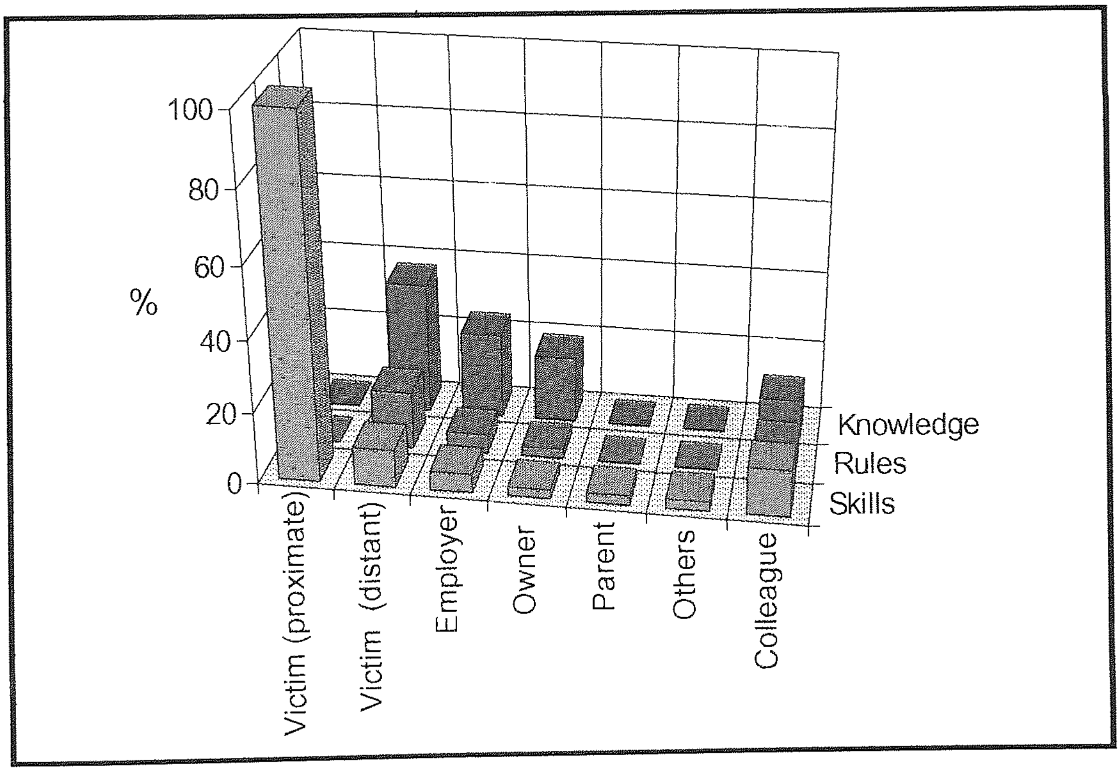


Figure 5.18 Skill rule and knowledge based errors where the proximate failure was E1 - percentages

(Source Figure J 2)

Figure 5.18 shows that most identifiable distant failures of those killed and employers, owners of machines and equipment, and colleagues present at the time of the accident, are knowledge based. Moreover Figure 5.19 shows that the majority of the distant errors by the deceaseds and errors by other parties, involved violations.

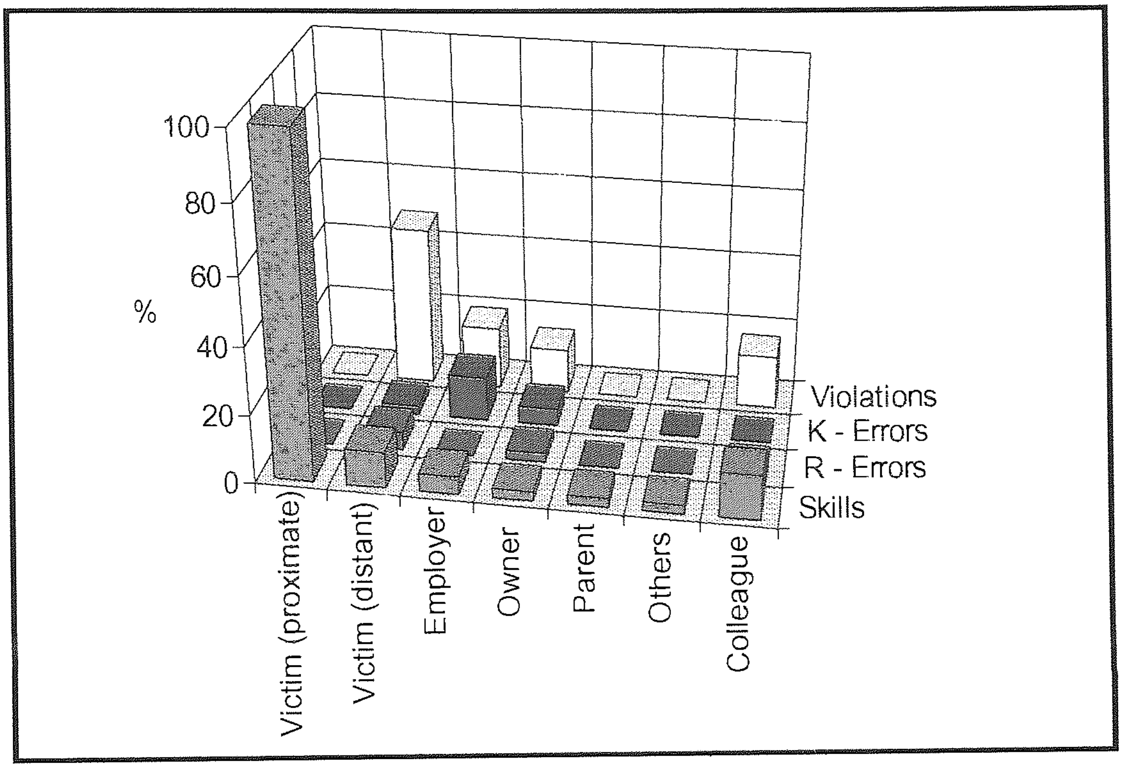


Figure 5.19 Skill rule and knowledge based errors and violations where the proximate failure was E1 - percentages

(Source Figure J 4)

Data relating to **All victims. (n=230)**

Males 209, Females 21.

Mean age = 40.02, Std Deviation 22.48 years.

Employment status	Full-time	Part-time	Casual	Not employed	Total	
Self employed/family	77	7	4	1	**89**	38.7%
Non employee	--	--	1	51	**52**	22.6%
Employees						
Director/manager/ foreman	6	--	--	--	**6**	2.6%
GFW/tractor driver	60	6	4	--	**70**	30.4%
Mechanic/maintenance worker	3	1	--	--	**4**	1.7%
Lorry driver	2	--	--	--	**2**	0.9%
Stockman/shepherd	2	1	1	--	**4**	1.7%
Contractor	3	--	--	--	**3**	1.3%
Total	**153**	**15**	**10**	**52**	**230**	
	66.5%	6.5%	4.3%	22.6%		

Table A.1 All victims - Employment status

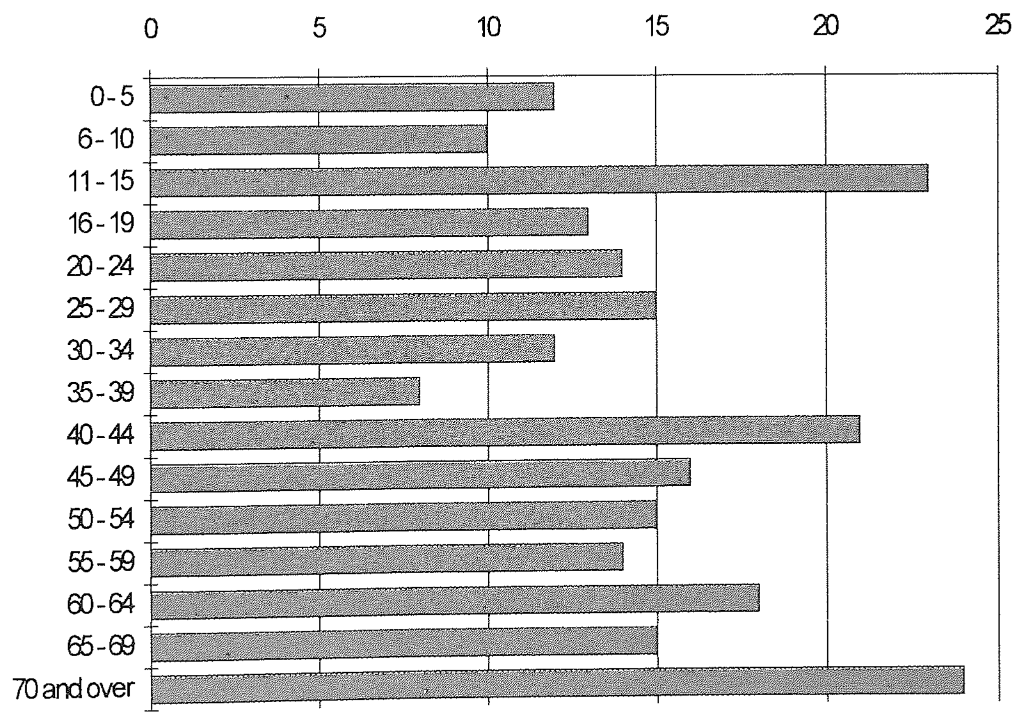


Figure A.1 All victims - Age distribution.

Ages of DP's	Number
Under 16	45
16 - 19	13
20 - 24	14
25 - 29	15
30 - 34	12
35 - 39	8
40 - 44	21
45 - 49	16
50 - 54	15
55 - 59	14
60 -64	18
65 and over	39
Total	**230**

Table A.2 All victims - Age distribution.

Month	Number
January	22
February	14
March	14
April	15
May	25
June	15
July	22
August	27
September	32
October	21
November	14
December	9
Total	**230**

Table A.3 All victims - Month

Survival	Number
Died within 24 hrs	180
Survived 1-7 days	31
Survived 8-14 days	8
Survived > 14 days	11
Total	**230**

Table A.4 All victims - Survival

Kind of accident	Number
Contact with moving machinery	26
Struck by moving object	32
Transport (hit by moving vehicle)	61
Struck against something	1
Injured while handling/lifting /carrying	0
Slip trip or fall on same level	5
Fall - 2 metres or less	22
Fall - over 2 metres	17
Fall - height not known	0
Trapped- collapsing/overturning	9
Drowning or asphyxiation	20
Exposure to harmful substance	2
Exposure to fire	5
Exposure to an explosion	0
Contact with electricity	13
Injured by an animal	17
Other kind of accident	0
Total	**230**

Table A.5 All victims - Kind of accident

Part of body	Number
Whole body	46
Head	52
Neck/spine	25
Ribs/chest	75
Abdomen	13
Shoulder - elbow	6
Lower arm - wrist	1
Hand - wrist	0
Hip/thigh	4
Lower leg	3
Foot	2
Could not code	3
Total	**230**

Table A.6 All victims - Site of injury

		Victim (prox'te)	Victim (distant)	Empl'r	Owner of Machy/land	Parent	Supplier	Manuf'r	Designer	HSE	Other eg Utility	Colleague
Skills	Correct response not in programme (A1)	15	1	--	--	--	--	--	--	--	--	--
	Response not correctly executed (E1)	38	3	--	1	--	--	--	--	--	--	3
	Procedure not correctly executed (E3)	18	4	6	6	3	2	--	--	--	--	8
	Plan/procedure not correctly executed (E7)	1	--	4	7	2	--	2	--	1	--	3
Rules	Correct test not chosen, or executed (B6)	3	2	3	--	1	--	2	--	--	--	1
	Correct procedure not known (D2)	37	6	2	10	4	--	--	--	--	--	19
	Correct procedure not chosen (D30	7	1	3	3	1	--	--	--	--	--	3
	Correct plan/procedure not chosen (D7)	2	4	6	2	2	--	--	1	1	--	3
Knowledge	Responsibility for action no accepted (C3)	45	23	10	23	12	3	1	--	1	--	12
	Need to test, not known/recognised (C4)	59	7	21	12	2	2	--	--	--	--	17
	Responsibility for testing no accepted (C5)	1	--	6	3	2	--	--	--	--	--	1
	Need for action not recognised (C6)	3	1	11	5	4	1	1	2	--	--	5
	Responsibility for action not accepted, allocated (C7)	1	1	3	3	1	--	1	--	--	--	1
		230	53	75	75	34	8	7	3	3		76

Table A.7 All victims - Distribution of errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	72	8	10	14	5	5	14
Rules	49	13	14	15	8	4	26
Knowledge	109	32	51	46	21	12	36
	230	53	75	75	34	21	76

Table A.8 All victims - Numbers of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	31.3	3.5	4.3	6.1	2.2	2.2	6.1
Rules	21.3	5.7	6.1	6.5	3.5	1.7	11.3
Knowledge	47.4	13.9	22.2	20.0	9.1	5.2	15.7
	100.0	23.0	32.6	32.6	14.8	9.1	33.0

Table A.9 All victims - Percentages of skill, rule, and knowledge based errors

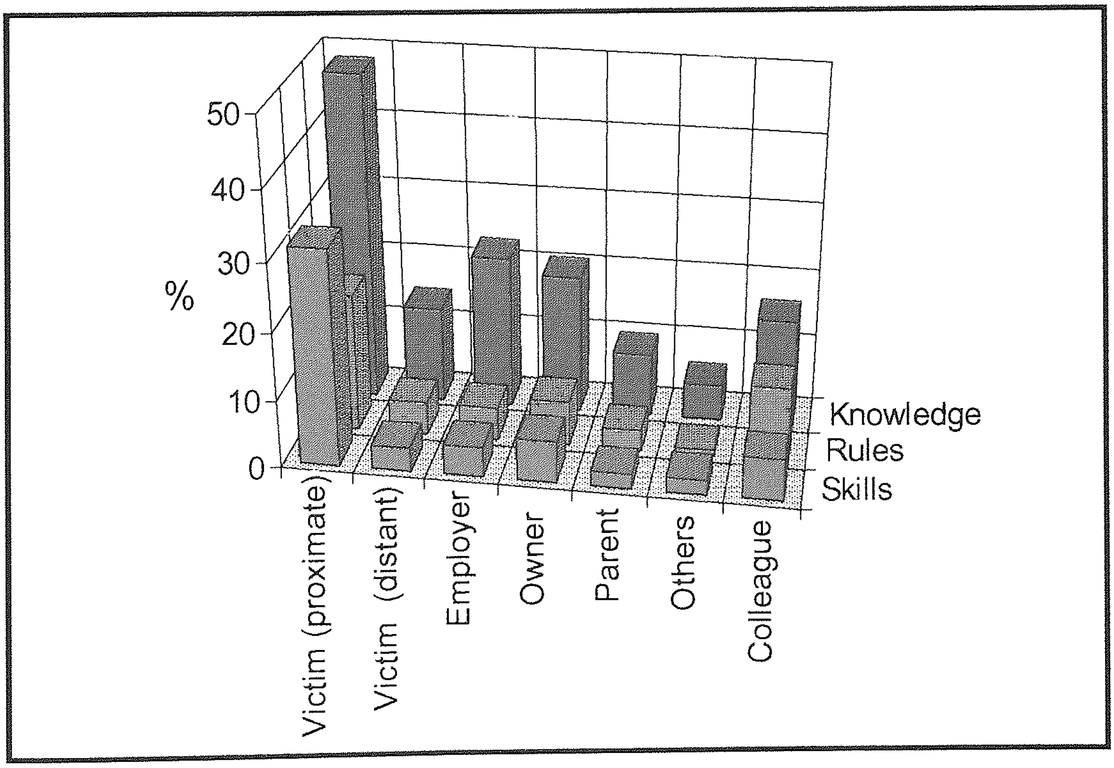


Figure A.2 All victims - Percentages of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	127	35	54	46	22	14	37
Control	103	18	21	29	12	7	39
	230	53	75	75	34	21	76

Table A.10 All victims - Identification/Assessment vs Control failures (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	55.2	15.2	23.5	20.0	9.6	6.1	16.1
Control	44.8	7.8	9.1	12.6	5.2	3.0	17.0
	100.0	23.0	32.6	32.6	14.8	9.1	33.0

Table A.11 All victims - Identification/Assessment vs Control failures (percentages)

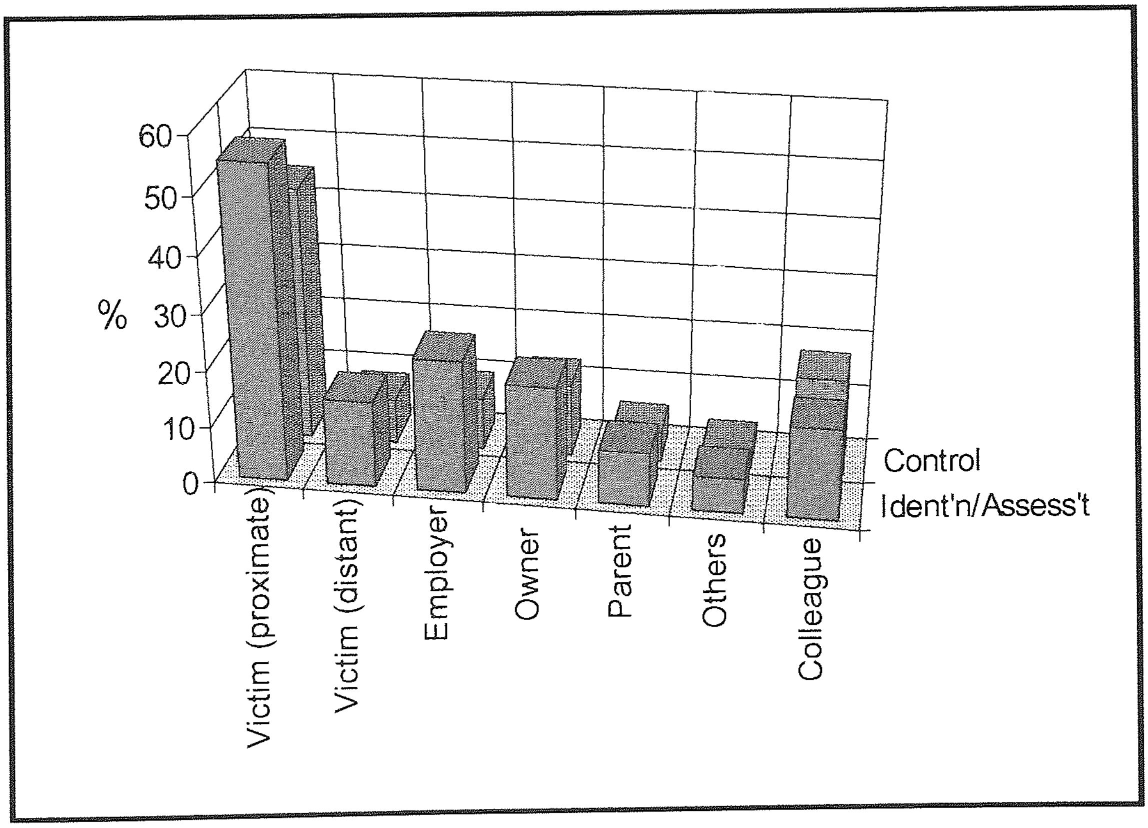


Figure A.3 All victims - Identification/Assessment vs Control failures (percentage)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	72	8	10	14	5	5	14
R - Errors	37	6	2	10	4	0	19
K - Errors	62	8	32	17	6	6	22
Violations	59	31	31	34	19	10	21
	230	53	75	75	34	21	76

Table A.12 All victims - Skill, rule, and knowledge based errors vs Violations (Number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	31.3	3.5	4.3	6.1	2.2	2.2	6.1
R - Errors	16.1	2.6	0.9	4.3	1.7	0.0	8.3
K - Errors	27.0	3.5	13.9	7.4	2.6	2.6	9.6
Violations	25.7	13.5	13.5	14.8	8.3	4.3	9.1
	100.0	23.0	32.6	32.6	14.8	9.1	33.0

Table A.13 All victims - Skill, rule, and knowledge based errors vs Violations (Percentage)

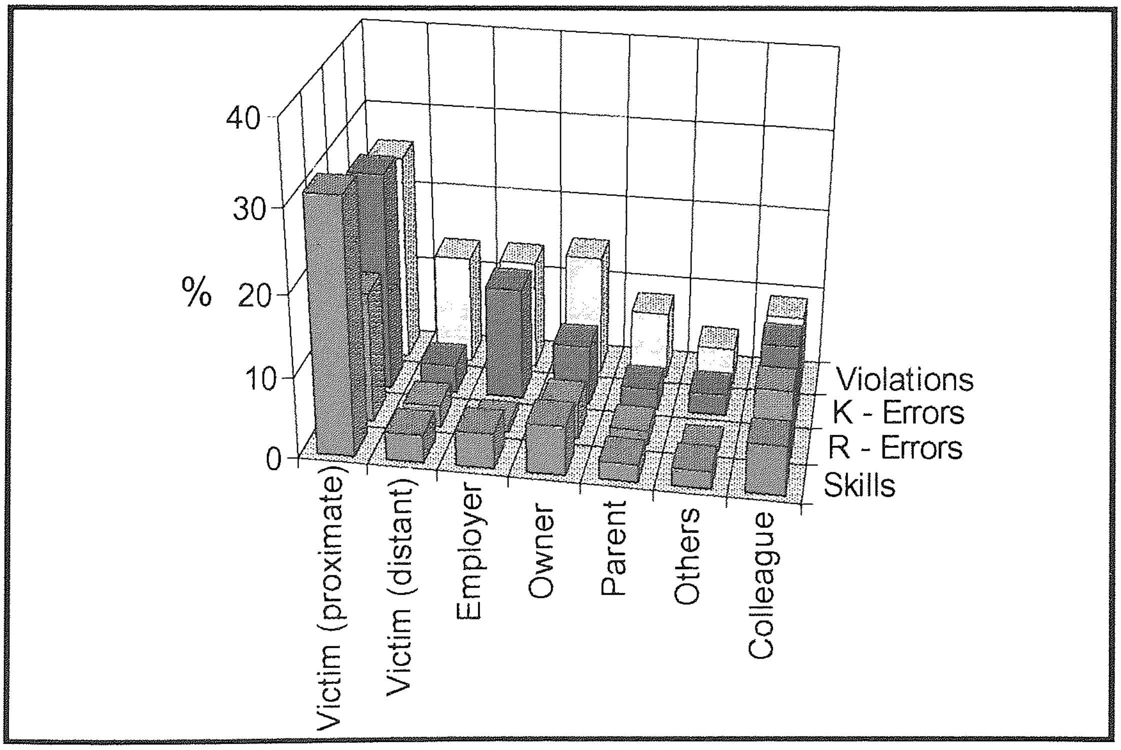


Figure A.4 All victims - Skill, rule, and knowledge based errors vs Violations (Percentage)

Data relating to **Self employed. (n=89)**

Males 85, Females 4.

Mean age = 47.51, Std Deviation 18.22 years.

Employment status	Full-time	Part-time	Casual	Not employed	Total	
Self employed/family	77	7	4	1	**89**	100.0%
Non employee	--	--	--	--	**0**	0.0%
Employees						
Director/manager/foreman	--	--	--	--	**0**	0.0%
GFW/tractor driver	--	--	--	--	**0**	0.0%
Mechanic/maintenance worker	--	--	--	--	**0**	0.0%
Lorry driver	--	--	--	--	**0**	0.0%
Stockman/shepherd	--	--	--	--	**0**	0.0%
Contractor	--	--	--	--	**0**	0.0%
Total	**77**	**7**	**4**	**1**	**89**	
	86.5%	7.9%	4.5%	1.1%		

Table B.1 Self employed - Employment status

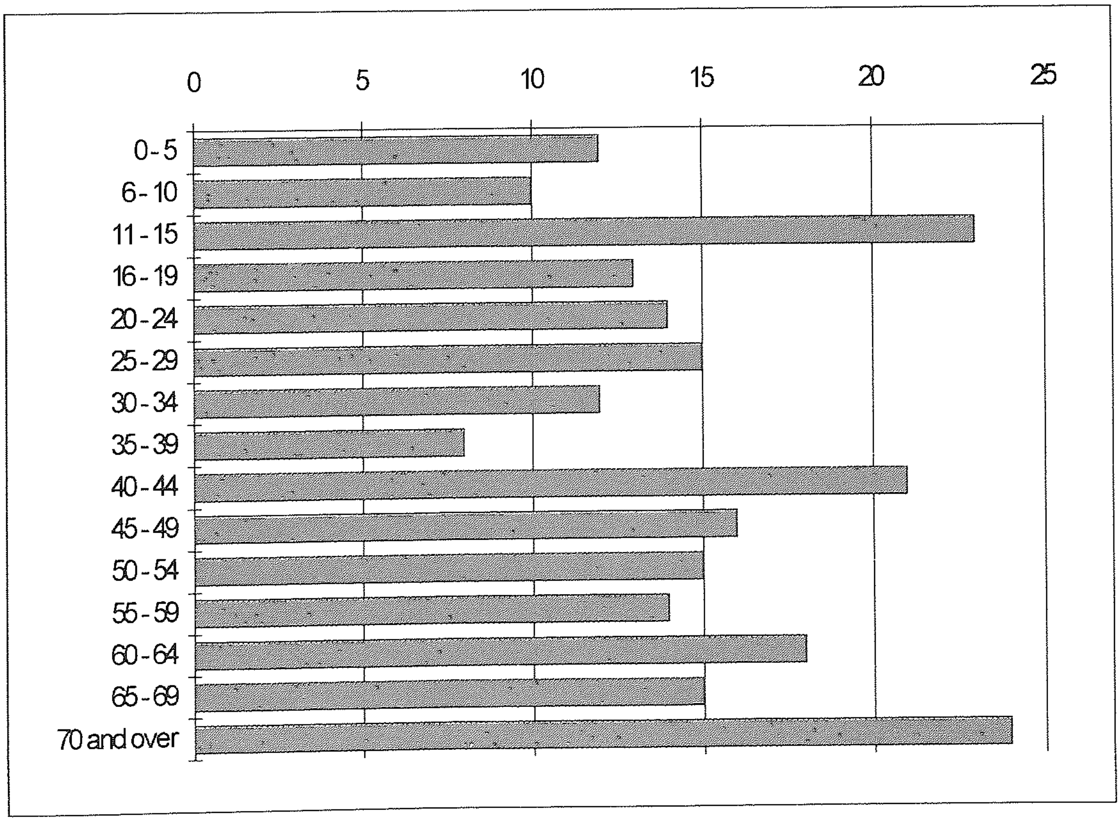


Figure B.1 Self employed - Age

Ages of DP's	Number
Under 16	3
16 - 19	2
20 - 24	6
25 - 29	7
30 - 34	6
35 - 39	5
40 - 44	15
45 - 49	7
50 - 54	4
55 - 59	8
60 -64	7
65 and over	19
Total	**89**

Table B.2 Self employed - Age

Month	Number
January	10
February	4
March	4
April	7
May	11
June	6
July	10
August	7
September	11
October	8
November	8
December	3
Total	**89**

Table B.3 Self employed - Month

Kind of accident	Number
Contact with moving machinery	11
Struck by moving object	12
Transport (hit by moving vehicle)	27
Struck against something	0
Injured while handling/lifting /carrying	0
Slip trip or fall on same level	2
Fall - 2 metres or less	6
Fall - over 2 metres	7
Fall - height not known	0
Trapped- collapsing/overturning	4
Drowning or asphyxiation	5
Exposure to harmful substance	1
Exposure to fire	0
Exposure to an explosion	0
Contact with electricity	7
Injured by an animal	7
Other kind of accident	0
Total	**89**

Table B.5 Self employed - Kind of accident

Survival	Number
Died within 24 hrs	67
Survived 1-7 days	14
Survived 8-14 days	5
Survived > 14 days	3
Total	**89**

Table B.4 Self employed - Survival

Part of body	Number
Whole body	22
Head	18
Neck/spine	9
Ribs/chest	26
Abdomen	7
Shoulder - elbow	3
Lower arm - wrist	0
Hand - wrist	0
Hip/thigh	2
Lower leg	1
Foot	0
Could not code	1
Total	**89**

Table B.6 Self employed - Site of injury

		Victim (prox'te)	Victim (distant)	Empl'r	Owner of Mach'y/land	Parent	Supplier	Manuf'r	Designer	HSE	Other body eg Utility	Colleague
Skills	Correct response not in programme (A1)	3	--	--	--	--	--	--	--	--	--	--
	Response not correctly executed (E1)	13	2	--	1	--	--	--	--	--	--	2
	Procedure not correctly executed (E3)	4	3	--	1	--	1	--	--	--	--	2
	Plan/procedure not correctly executed (E7)	--	--	--	1	--	--	1	--	--	--	--
Rules	Correct test not chosen, or executed (B6)	--	--	--	--	--	--	--	--	--	--	--
	Correct procedure not known (D2)	19	4	--	4	--	--	--	--	--	--	10
	Correct procedure not chosen (D3)	1	1	--	1	--	--	--	--	--	--	1
	Correct plan/procedure not chosen (D7)	1	--	1	--	--	--	--	--	--	--	1
Knowledge	Responsibility for action not accepted (C3)	28	14	--	3	--	2	--	--	1	--	8
	Need to test, not known/recognised (C4)	19	4	--	4	--	1	--	--	--	--	7
	Responsibility for testing not accepted (C5)	1	--	--	--	--	--	--	--	--	--	1
	Need for action not recognised (C6)	--	--	--	1	2	1	--	1	--	--	--
	Responsibility for action not accepted, allocated (C7)	--	1	--	1	1	--	1	--	--	--	--
		89	29	1	17	3	5	2	1	1		32

Table B.7 Self employed - Distribution of errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	20	5	0	3	0	2	4
Rules	22	5	1	5	0	0	13
Knowledge	47	19	0	9	3	7	15
	89	29	1	17	3	9	32

Table B.8 Self employed - Numbers of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	22.5	5.6	0.0	3.4	0.0	2.2	4.5
Rules	24.7	5.6	1.1	5.6	0.0	0.0	14.6
Knowledge	52.8	21.3	0.0	10.1	3.4	7.9	16.9
	100.0	23.6	1.1	15.7	3.4	10.1	36.0

Table B.9 Self employed - Percentages of skill, rule, and knowledge based errors

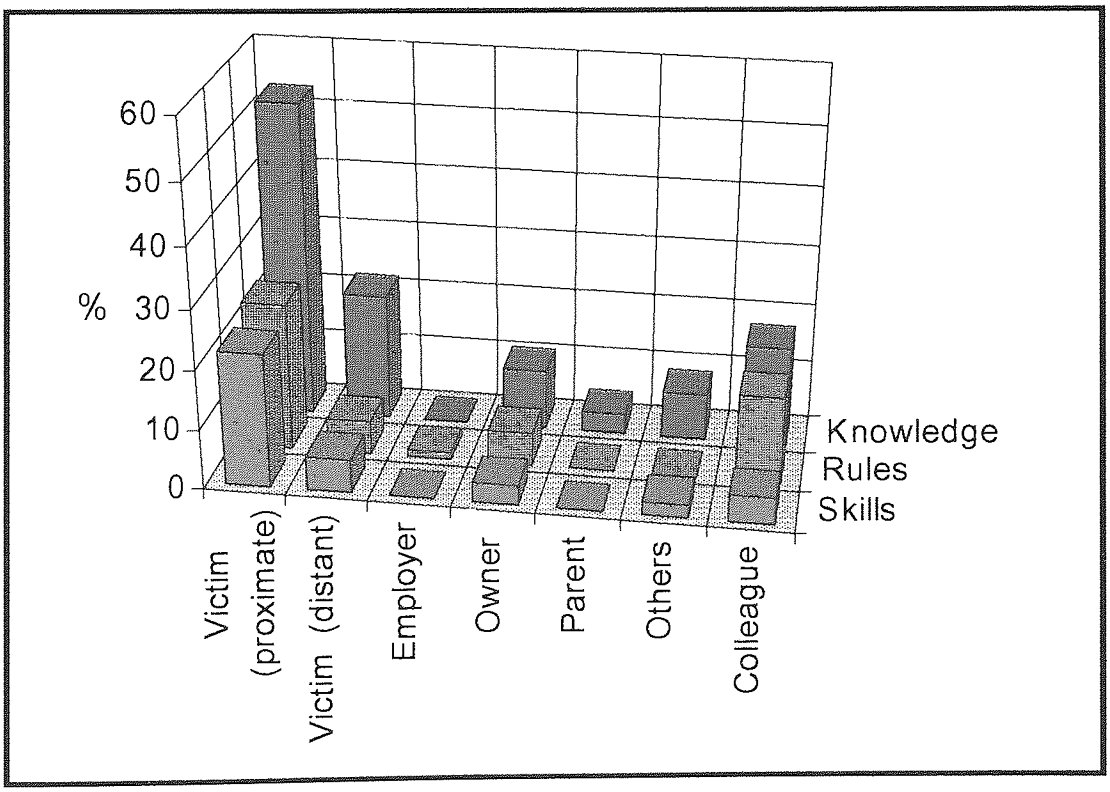


Figure B.2 Self employed - Percentages of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	51	19	0	9	3	7	16
Control	38	10	1	8	0	2	16
	89	29	1	17	3	9	32

Table B.10 Self employed - Identification/Assessment vs Control failures (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	57.3	21.3	0.0	10.1	3.4	7.9	18.0
Control	42.7	11.2	1.1	9.0	0.0	2.2	18.0
	100.0	32.6	1.1	19.1	0.0	10.1	36.0

Table B.11 Self employed - Identification/Assessment vs Control failures (percentage)

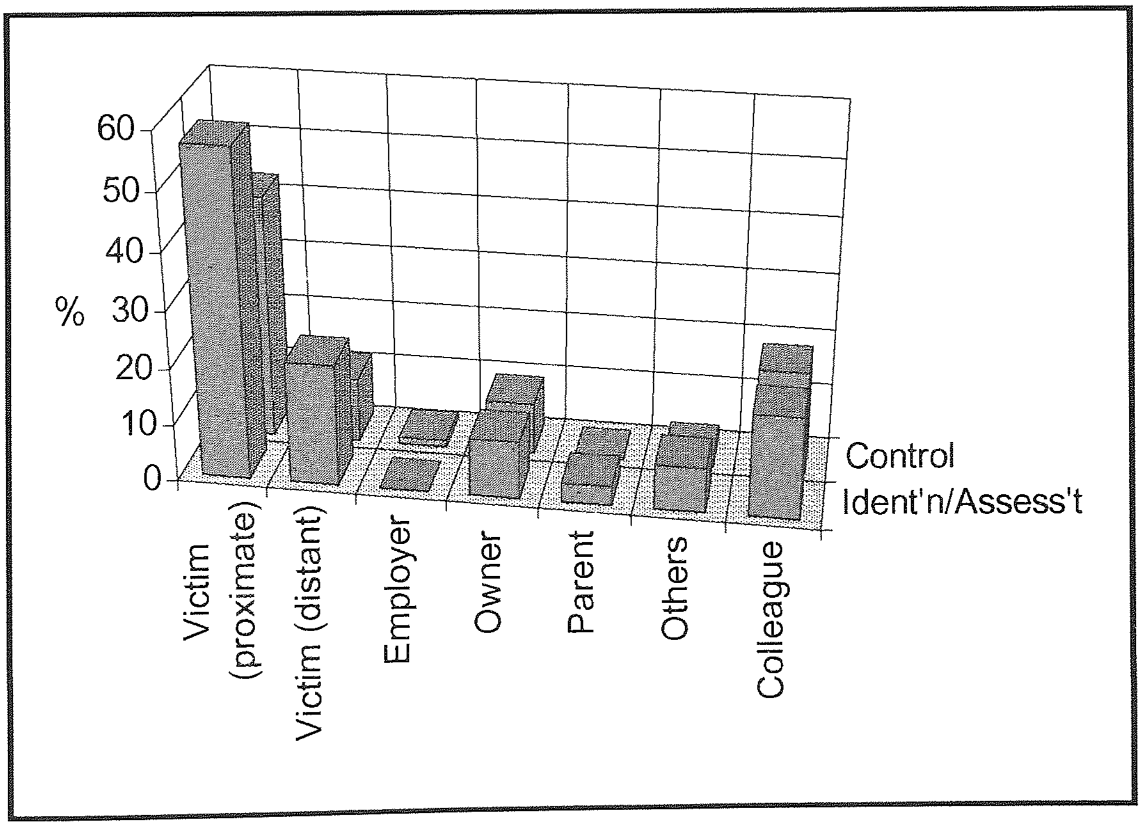


Figure B.3 Self employed - Identification/Assessment vs Control failures (percentage)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	20	5	0	3	0	2	4
R - Errors	19	4	0	4	0	0	10
K - Errors	19	4	0	5	2	3	7
Violations	31	16	1	5	1	4	11
	89	29	1	17	3	9	32

Table B.12 Self employed - Skill, rule, and knowledge based errors vs Violations (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	22.5	5.6	0.0	3.4	0.0	2.2	4.5
R - Errors	21.3	4.5	0.0	4.5	0.0	0.0	11.2
K - Errors	21.3	4.5	0.0	5.6	2.2	3.4	7.9
Violations	34.8	18.0	1.1	5.6	1.1	4.5	12.4
	100.0	32.6	1.1	19.1	3.4	10.1	36.0

Table B.13 Self employed - Skill, rule, and knowledge based errors vs Violations (percentage)

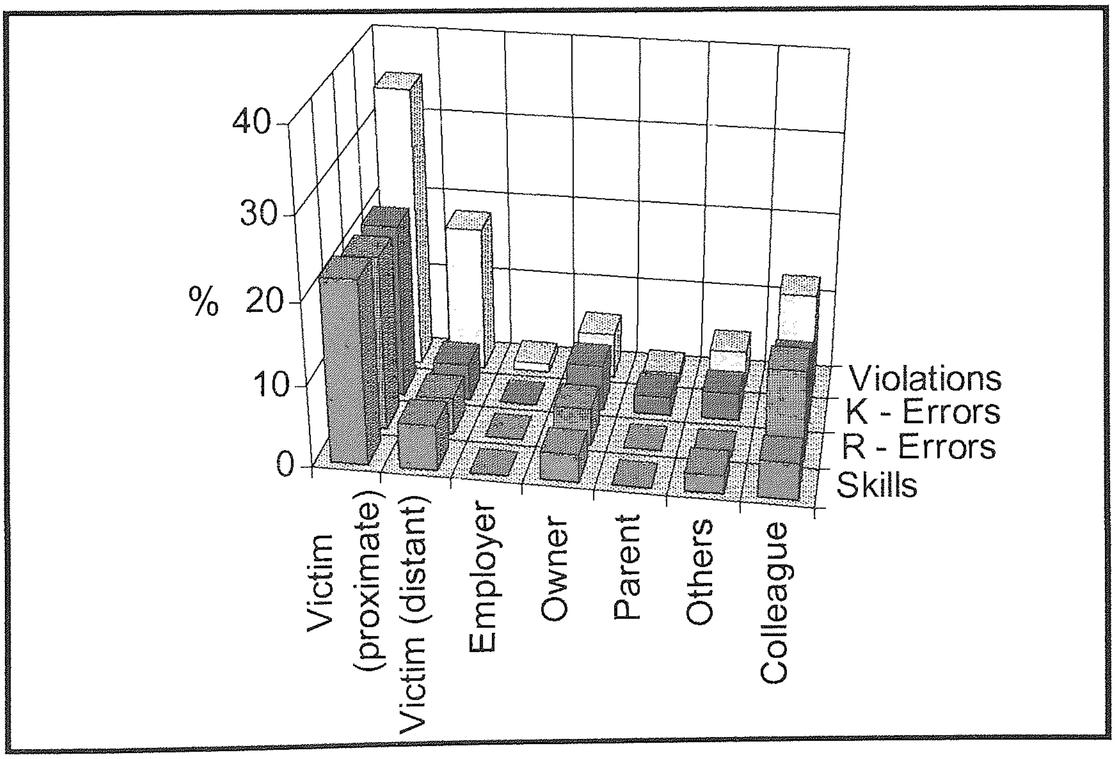


Figure B.4 Self employed - Skill, rule, and knowledge based errors vs Violations

Data relating to **Employees. (n=89)**

Males 83, Females 6.

Mean age = 44.16, Std Deviation 18.54 years.

Employment status	Full-time	Part-time	Casual	Not employed	Total	
Self employed/family	--	--	--	--	**0**	0.0%
Non employee	--	--	--	--	**0**	0.0%
Employees						
Director/manager/ foreman	6	--	--	--	**6**	6.7%
GFW/tractor driver	60	6	4	--	**70**	78.7%
Mechanic/maintenance worker	3	1	--	--	**4**	4.5%
Lorry driver	2	--	--	--	**2**	2.2%
Stockman/shepherd	2	1	1	--	**4**	4.5%
Contractor	3	--	--	--	**3**	3.4%
Total	**76**	**8**	**5**	**0**	**89**	
	85.4%	9.0%	5.6%	0.0%		

Table C.1 Employees - Employment status

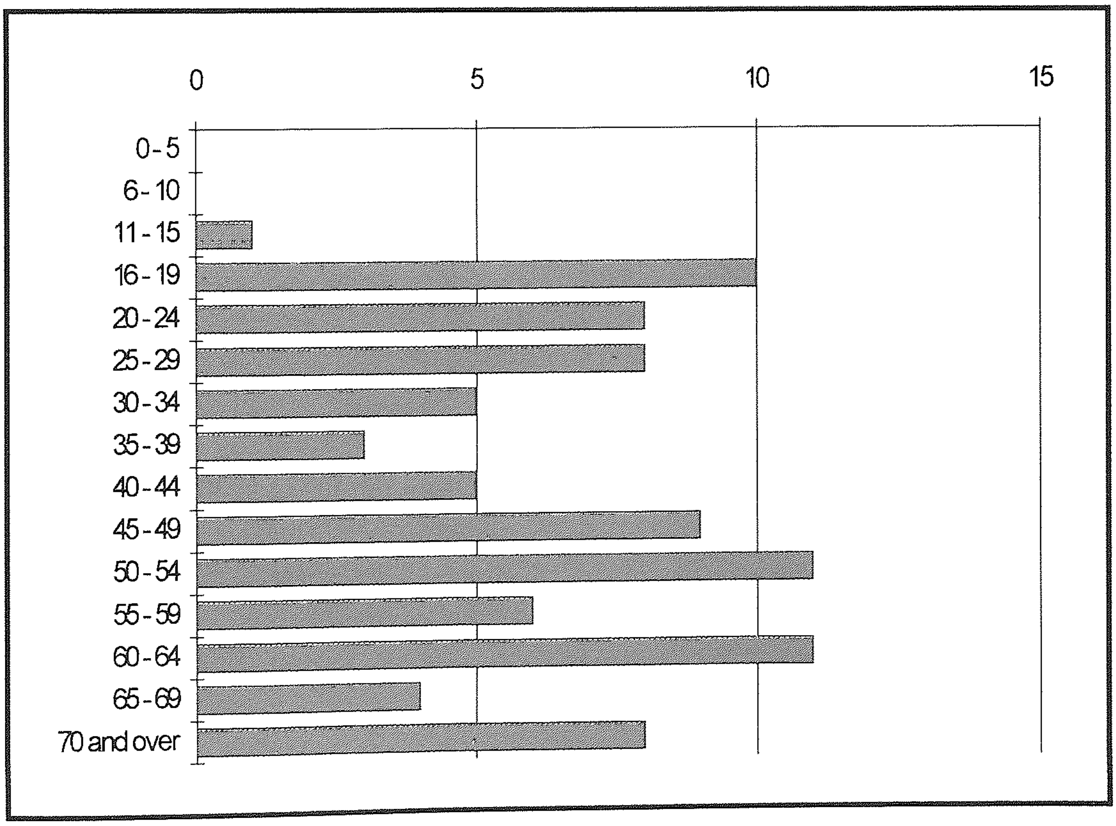


Figure C.1 Employees - Age distribution.

Ages of DP's	Number
Under 16	1
16 - 19	10
20 - 24	8
25 - 29	8
30 - 34	5
35 - 39	3
40 - 44	5
45 - 49	9
50 - 54	11
55 - 59	6
60 -64	11
65 and over	12
Total	**89**

Table C.2 Employees - Age distribution.

Month	Number
January	10
February	8
March	5
April	3
May	9
June	6
July	7
August	13
September	12
October	8
November	4
December	4
Total	**89**

Table C.3 Employees - Month

Survival	Number
Died within 24 hrs	66
Survived 1-7 days	15
Survived 8-14 days	3
Survived > 14 days	5
Total	**89**

Table C.4 Employees - Survival

Kind of accident	Number
Contact with moving machinery	10
Struck by moving object	16
Transport (hit by moving vehicle)	21
Struck against something	1
Injured while handling/lifting /carrying	0
Slip trip or fall on same level	2
Fall - 2 metres or less	8
Fall - over 2 metres	10
Fall - height not known	0
Trapped- collapsing/overturning	4
Drowning or asphyxiation	5
Exposure to harmful substance	1
Exposure to fire	2
Exposure to an explosion	0
Contact with electricity	4
Injured by an animal	5
Other kind of accident	0
Total	**89**

Table C.5 Employees - Kind of accident

Part of body	Number
Whole body	13
Head	21
Neck/spine	10
Ribs/chest	32
Abdomen	3
Shoulder - elbow	2
Lower arm - wrist	1
Hand - wrist	0
Hip/thigh	2
Lower leg	2
Foot	2
Could not code	1
Total	**89**

Table C.6 Employees - Site of injury

		Victim (prox'te)	Victim (distant)	Empl'r	Owner of Mach'y/land	Parent	Supplier	Manuf'r	Designer	HSE	Other body eg Utility	Colleague
Skills	Correct response not in programme (A1)	4	1	--	--	--	--	--	--	--	--	--
	Response not correctly executed (E1)	18	--	--	--	--	--	--	--	--	--	--
	Procedure not correctly executed (E3)	12	1	6	2	--	1	--	--	--	--	5
	Plan/procedure not correctly executed (E7)	1	--	4	1	--	--	1	--	1	--	2
Rules	Correct test not chosen, or executed (B6)	2	2	3	--	--	--	2	--	--	--	--
	Correct procedure not known (D2)	12	2	2	1	--	--	--	--	--	--	5
	Correct procedure not chosen (D3)	5	--	3	1	--	--	--	--	--	--	2
	Correct plan/procedure not chosen (D7)	1	3	5	--	--	--	--	1	--	--	2
Knowledge	Responsibility for action not accepted (C3)	14	8	10	5	--	--	1	--	--	--	2
	Need to test, not known/recognised (C4)	17	3	19	3	--	1	--	--	--	--	6
	Responsibility for testing not accepted (C5)	--	--	4	1	--	--	--	--	--	--	--
	Need for action not recognised (C6)	3	1	11	--	--	--	1	1	--	--	4
	Responsibility for action not accepted, allocated (C7)	--	--	2	--	--	--	--	--	--	--	1
		89	**21**	**69**	**14**		**2**	**5**	**2**	**1**		**29**

Table C.7 Employees - Distribution of errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	35	2	10	3	0	3	7
Rules	20	7	17	3	0	3	9
Knowledge	34	12	42	8	0	4	13
	89	21	69	14	0	10	29

Table C.8 Employees - Numbers of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	39.3	2.2	11.2	3.4	0.0	3.4	7.9
Rules	22.5	7.9	19.1	3.4	0.0	3.4	10.1
Knowledge	38.2	13.5	47.2	9.0	0.0	4.5	14.6
	100.0	23.6	77.5	15.7	0.0	11.2	32.6

Table C.9 Employees - Percentages of skill, rule, and knowledge based errors

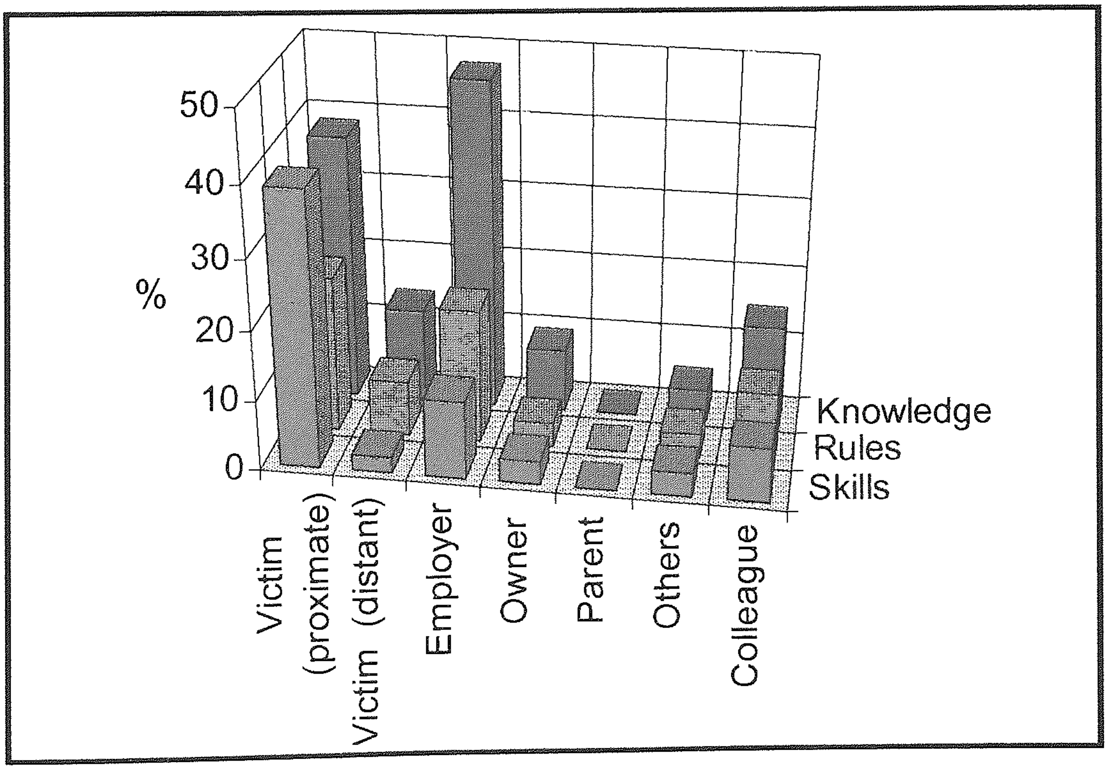


Figure C.2 Employees - Percentages of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	40	15	49	9	0	6	13
Control	49	6	20	5	0	4	16
	89	21	69	14	0	10	29

Table C.10 Employees - Identification/Assessment vs Control failures (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	44.9	16.9	55.1	10.1	0.0	6.7	14.6
Control	55.1	6.7	22.5	5.6	0.0	4.5	18.0
	100.0	23.0	32.6	32.6	0.0	11.2	32.6

Table C.11 Employees - Identification/Assessment vs Control failures (percentage)

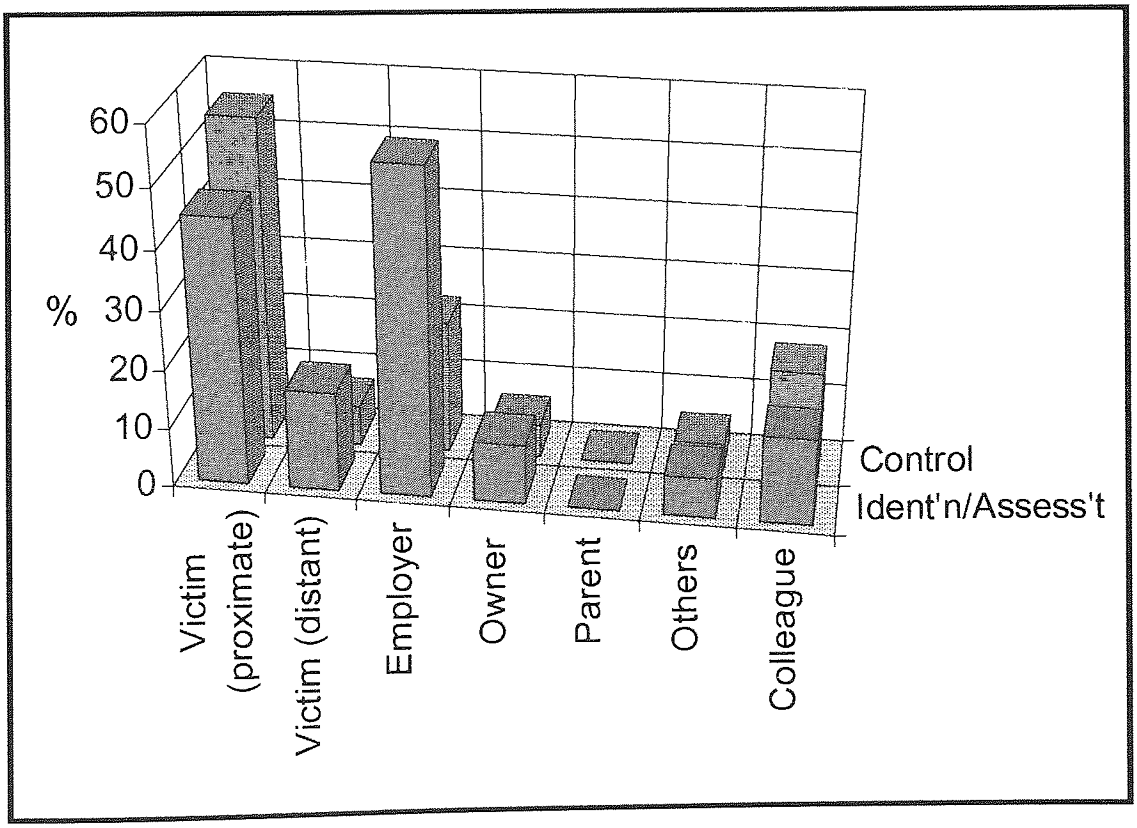


Figure C.3 Employees - Identification/Assessment vs Control failures (percentage)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	35	2	10	3	0	3	7
R - Errors	12	2	2	1	0	0	5
K - Errors	20	4	30	3	0	3	10
Violations	22	13	27	7	0	4	7
	89	21	75	14	0	10	29

Table C.12 Employees - Skill, rule, and knowledge based errors vs Violations (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	39.3	2.2	11.2	3.4	0.0	3.4	7.9
R - Errors	13.5	2.2	2.2	1.1	0.0	0.0	5.6
K - Errors	22.5	4.5	33.7	3.4	0.0	3.4	11.2
Violations	24.7	14.6	30.3	7.9	0.0	4.5	7.9
	100.0	23.6	84.3	15.7	0.0	11.2	32.6

Table C.13 Employees - Skill, rule, and knowledge based errors vs Violations (percentage)

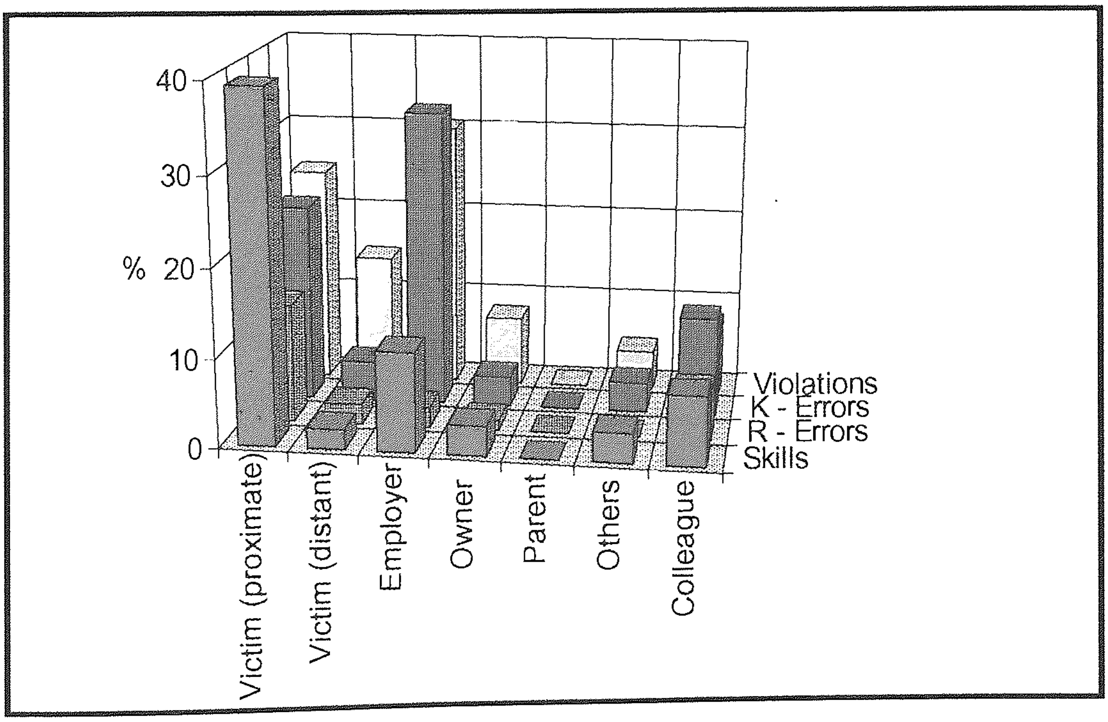


Figure C.4 Employees - Skill, rule, and knowledge based errors vs Violations

Data relating to

Children aged 0 - 15. (n=45)

Males 35, Females 10.

Mean age = 9.51, Std Deviation 4.66 years.

Employment status	Full-time	Part-time	Casual	Not employed	Total	
Self employed/family	--	--	3	--	**3**	6.7%
Non employee	--	--	1	40	**41**	91.1%
Employees						
Director/manager/ foreman	--	--	--	--	**0**	0.0%
GFW/tractor driver	--	--	1	--	**1**	2.2%
Mechanic/maintenance worker	--	--	--	--	**0**	0.0%
Lorry driver	--	--	--	--	**0**	0.0%
Stockman/shepherd	--	--	--	--	**0**	0.0%
Contractor	--	--	--	--	**0**	0.0%
Total	**0**	**0**	**5**	**40**	**45**	
	0.0%	0.0%	11.1%	88.9%		

Table D.1 Children - Employment status

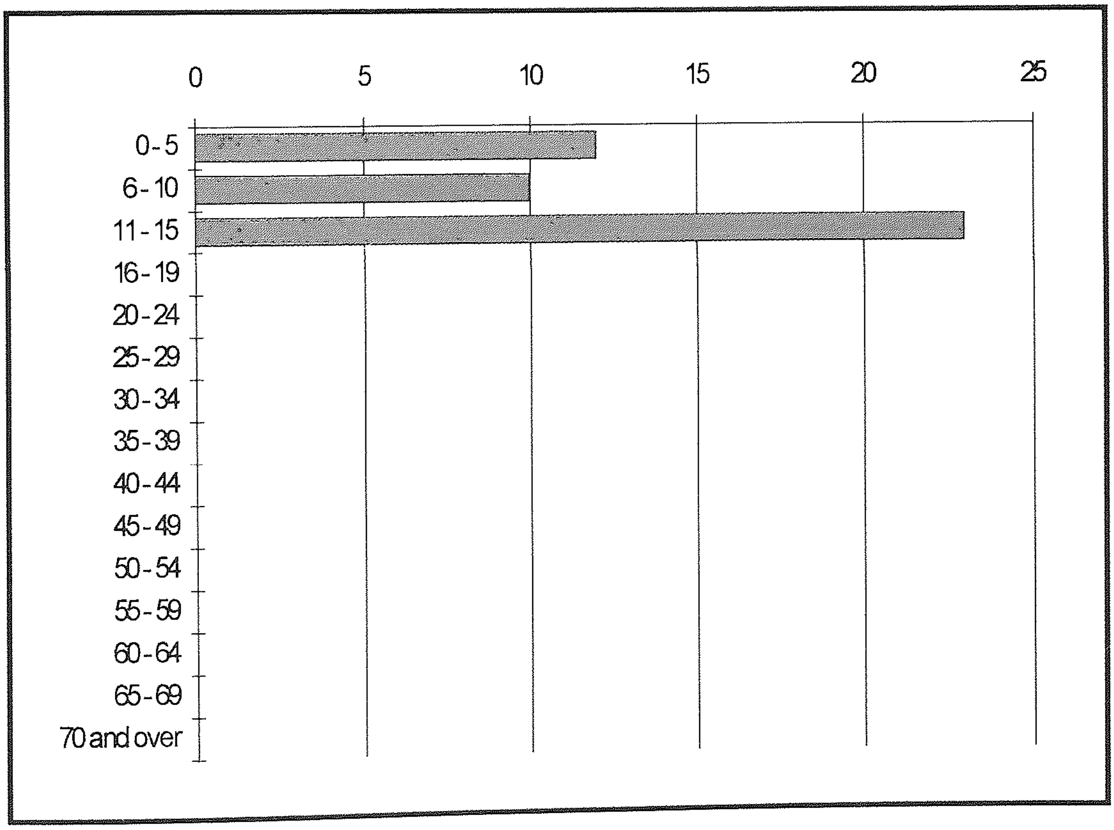


Figure D.1 Children - Age distribution.

Ages of DP's	Number
Under 16	45
16 - 19	0
20 - 24	0
25 - 29	0
30 - 34	0
35 - 39	0
40 - 44	0
45 - 49	0
50 - 54	0
55 - 59	0
60 -64	0
65 and over	0
Total	**45**

Table D.2 Children - Age

Month	Number
January	2
February	2
March	4
April	5
May	5
June	1
July	4
August	6
September	8
October	4
November	2
December	2
Total	**45**

Table D.3 Children - Month

Survival	Number
Died within 24 hrs	43
Survived 1-7 days	2
Survived 8-14 days	0
Survived > 14 days	0
Total	**45**

Table D.4 Children - Survival

Kind of accident	Number
Contact with moving machinery	4
Struck by moving object	3
Transport (hit by moving vehicle)	13
Struck against something	0
Injured while handling/lifting /carrying	0
Slip trip or fall on same level	0
Fall - 2 metres or less	8
Fall - over 2 metres	0
Fall - height not known	0
Trapped- collapsing/overturning	0
Drowning or asphyxiation	10
Exposure to harmful substance	1
Exposure to fire	3
Exposure to an explosion	0
Contact with electricity	2
Injured by an animal	1
Other kind of accident	0
Total	**45**

Table D.5 Children - Kind of accident

Part of body	Number
Whole body	11
Head	12
Neck/spine	5
Ribs/chest	13
Abdomen	2
Shoulder - elbow	1
Lower arm - wrist	0
Hand - wrist	0
Hip/thigh	0
Lower leg	0
Foot	0
Could not code	1
Total	**45**

Table D.6 Children - Site of injury

		Victim (prox'te)	Victim (distant)	Empl'r	Owner of Mach'y/land	Parent	Supplier	Manuf'r	Designer	HSE	Other body eg Utility	Colleague
Skills	Correct response not in programme (A1)	9	--	--	--	--	--	--	--	--	--	--
	Response not correctly executed (E1)	2	--	--	--	--	--	--	--	--	--	1
	Procedure not correctly executed (E3)	3	--	--	3	3	--	--	--	--	--	1
	Plan/procedure not correctly executed (E7)	--	--	--	3	2	--	--	--	--	--	1
Rules	Correct test not chosen, or executed (B6)	1	--	--	--	1	--	--	--	--	--	1
	Correct procedure not known (D2)	5	--	--	5	4	--	--	--	--	--	3
	Correct procedure not chosen (D3)	1	--	--	1	1	--	--	--	--	--	--
	Correct plan/procedure not chosen (D7)	--	--	--	2	2	--	--	--	1	--	--
Knowledge	Responsibility for action not accepted (C3)	3	1	--	12	12	1	--	--	--	--	--
	Need to test, not known/recognised (C4)	20	--	--	4	2	--	--	--	--	--	4
	Responsibility for testing not accepted (C5)	--	--	2	2	2	--	--	--	--	--	--
	Need for action not recognised (C6)	--	--	--	5	4	--	--	--	--	--	2
	Responsibility for action not accepted, allocated (C7)	1	--	--	3	1	--	--	--	--	--	--
		45	1	2	40	34	1			1		13

Table D.7 Children - Distribution of errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	14	0	0	6	5	0	3
Rules	7	0	2	10	10	1	4
Knowledge	24	1	0	24	19	1	6
	45	1	2	40	34	2	13

Table D.8 Children - Numbers of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	31.1	0.0	0.0	13.3	11.1	0.0	6.7
Rules	15.6	0.0	4.4	22.2	22.2	2.2	8.9
Knowledge	53.3	2.2	0.0	53.3	42.2	2.2	13.3
	100.0	2.2	4.4	88.9	75.6	4.4	28.9

Table D.9 Children - Percentages of skill, rule, and knowledge based errors

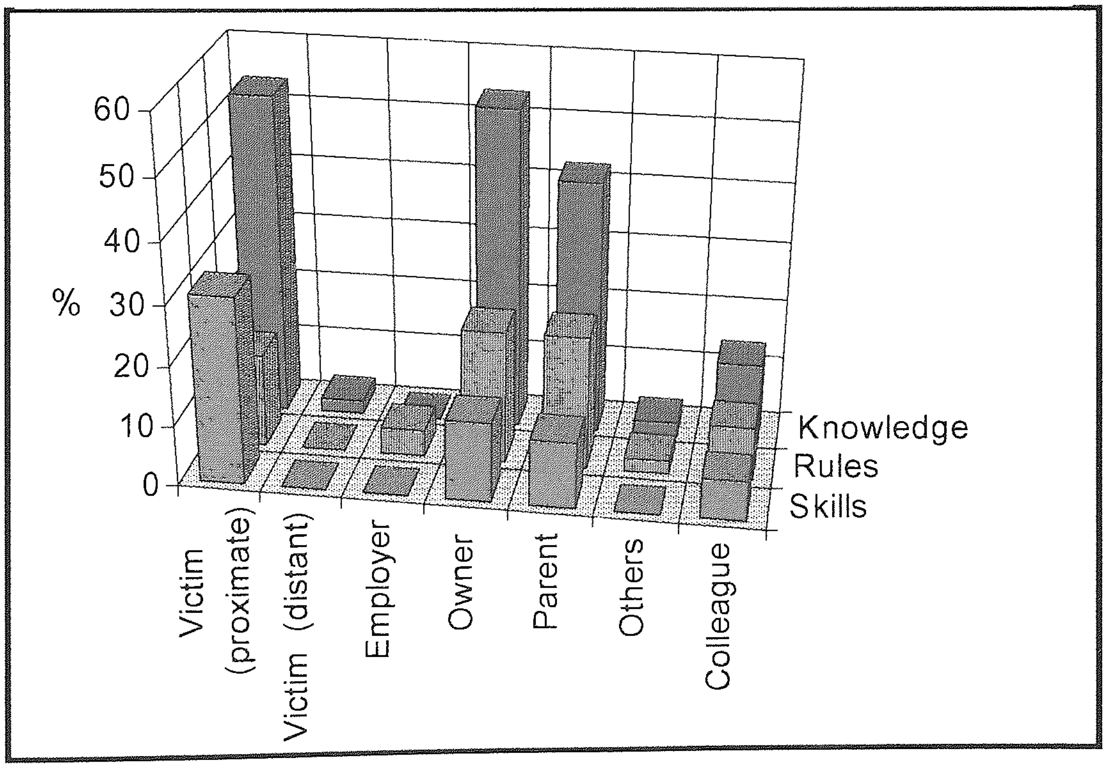


Figure D.2 Children - Percentages of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	34	1	2	26	22	1	7
Control	11	0	0	14	12	1	6
	45	1	2	40	34	2	13

Table D.10 Children - Identification/Assessment vs Control failures (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	75.6	2.2	4.4	57.8	48.9	2.2	15.6
Control	24.4	0.0	0.0	31.1	26.7	2.2	13.3
	100.0	2.2	4.4	88.9	75.6	4.4	28.9

Table D.11 Children - Identification/Assessment vs Control failures (percentage)

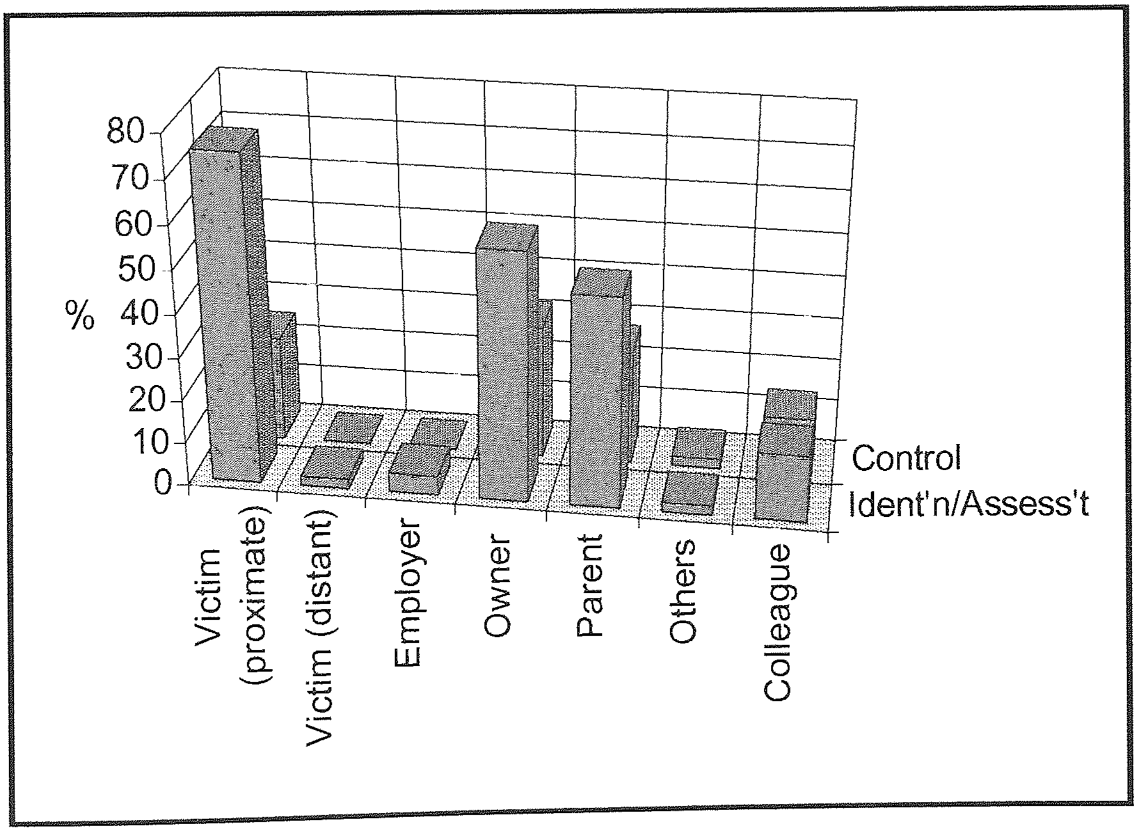


Figure D.3 Children - Identification/Assessment vs Control failures (percentage)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	14	0	0	6	5	0	3
R - Errors	5	0	0	5	4	0	3
K - Errors	20	0	0	9	6	0	6
Violations	6	1	2	20	19	2	1
	45	1	2	40	34	2	13

Table D.12 Children - Skill, rule, and knowledge based errors vs Violations (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	31.1	0.0	0.0	13.3	11.1	0.0	6.7
R - Errors	11.1	0.0	0.0	11.1	8.9	0.0	6.7
K - Errors	44.4	0.0	0.0	20.0	13.3	0.0	13.3
Violations	13.3	2.2	4.4	44.4	42.2	4.4	2.2
	100.0	2.2	4.4	88.9	75.6	4.4	28.9

Table D.13 Children - Skill, rule, and knowledge based errors vs Violations (percentage)

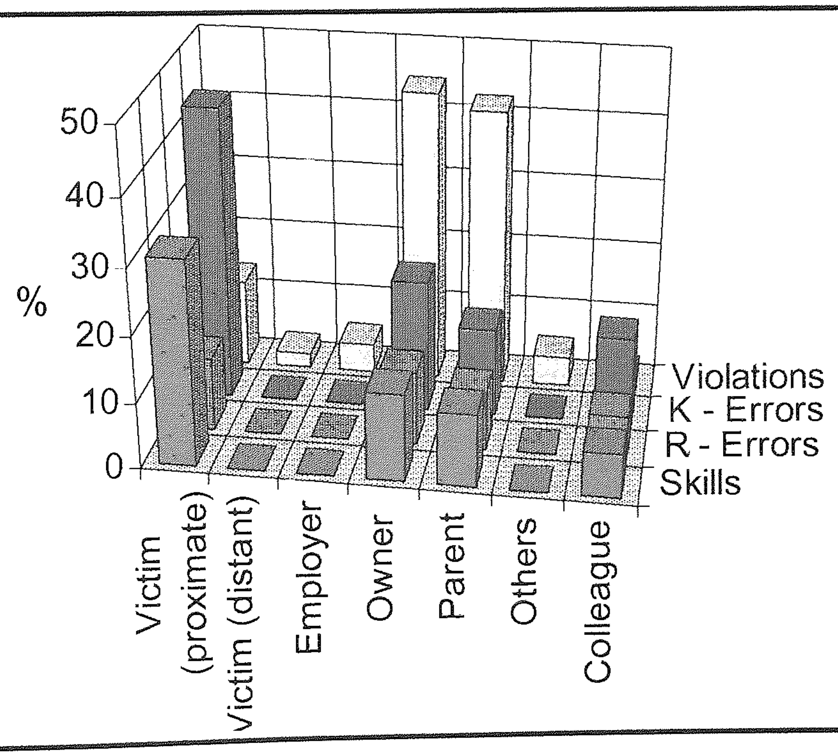


Figure D.4 Children - Skill, rule, and knowledge based errors vs Violations (percentage)

Data relating to **Falls. (n=39)**

Males 34, Females 5.

Mean age = 43.92, Std Deviation 24.96 years.

Employment status	Full-time	Part-time	Casual	Not employed	Total	
Self employed/family	12	1	--	--	**13**	33.3%
Non employee	--	--	--	8	**8**	20.5%
Employees						
Director/manager/ foreman	1	--	--	--	**1**	2.6%
GFW/tractor driver	11	1	2	--	**14**	35.9%
Mechanic/maintenance worker	1	--	--	--	**1**	2.6%
Lorry driver	1	--	--	--	**1**	2.6%
Stockman/shepherd	--	--	1	--	**1**	2.6%
Contractor	--	--	--	--	**0**	0.0%
Total	**26**	**2**	**3**	**8**	**39**	
	66.7%	5.1%	7.7%	20.5%		

Table E.1 Falls - Employment status

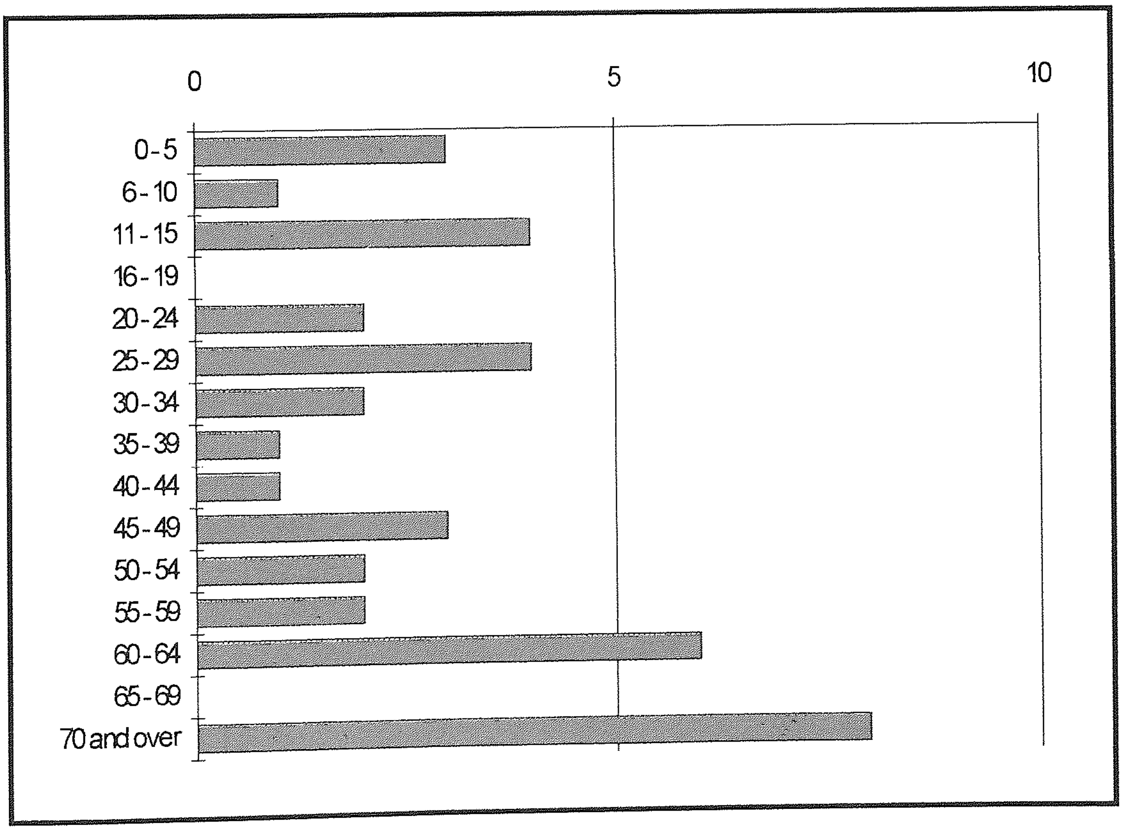


Figure E.1 Falls - Age distribution.

Ages of DP's	Number
Under 16	8
16 - 19	0
20 - 24	2
25 - 29	4
30 - 34	2
35 - 39	1
40 - 44	1
45 - 49	3
50 - 54	2
55 - 59	2
60 -64	6
65 and over	8
Total	39

Table E.2 Falls - Age distribution.

Month	Number
January	6
February	1
March	3
April	2
May	3
June	2
July	4
August	5
September	4
October	6
November	2
December	1
Total	39

Table E.3 Falls - Month

Survival	Number
Died within 24 hrs	19
Survived 1-7 days	14
Survived 8-14 days	4
Survived > 14 days	2
Total	39

Table E.4 Falls - Survival

Kind of accident	Number
Contact with moving machinery	0
Struck by moving object	0
Transport (hit by moving vehicle)	0
Struck against something	0
Injured while handling/lifting /carrying	0
Slip trip or fall on same level	0
Fall - 2 metres or less	22
Fall - over 2 metres	17
Fall - height not known	0
Trapped- collapsing/overturning	0
Drowning or asphyxiation	0
Exposure to harmful substance	0
Exposure to fire	0
Exposure to an explosion	0
Contact with electricity	0
Injured by an animal	0
Other kind of accident	0
Total	39

Table E.5 Falls - Kind of accident

Part of body	Number
Whole body	5
Head	18
Neck/spine	6
Ribs/chest	5
Abdomen	3
Shoulder - elbow	0
Lower arm - wrist	0
Hand - wrist	0
Hip/thigh	1
Lower leg	0
Foot	0
Could not code	1
Total	39

Table E.6 Falls - Site of injury

		Victim (prox'te)	Victim (distant)	Empl'r	Owner of Mach'y/land	Parent	Supplier	Manuf'r	Designer	HSE	Other body eg Utility	Colleague
Skills	Correct response not in programme (A1)	2	--	--	--	--	--	--	--	--	--	--
	Response not correctly executed (E1)	8	1	--	--	--	--	--	--	--	--	--
	Procedure not correctly executed (E3)	4	2	2	1	--	--	--	--	--	--	1
	Plan/procedure not correctly executed (E7)	--	--	--	1	1	--	--	--	--	--	1
Rules	Correct test not chosen, or executed (B6)	1	--	--	--	--	--	--	--	--	--	--
	Correct procedure not known (D2)	7	--	1	2	--	--	--	--	--	--	1
	Correct procedure not chosen (D3)	3	--	2	--	--	--	--	--	--	--	--
	Correct plan/procedure not chosen (D7)	--	--	4	1	1	--	--	--	--	--	--
Knowledge	Responsibility for action not accepted (C3)	8	5	2	8	4	1	1	--	--	--	2
	Need to test, not known/recognised (C4)	5	--	1	2	1	--	--	--	--	--	1
	Responsibility for testing not accepted (C5)	--	--	--	--	--	--	--	--	--	--	--
	Need for action not recognised (C6)	--	--	--	--	--	--	--	1	--	--	1
	Responsibility for action not accepted, allocated (C7)	1	--	2	1	--	--	--	--	--	--	--
		39	8	14	16	7	1	1	1			7

Table E.7 Falls - Distribution of errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	14	3	2	2	1	0	2
Rules	11	0	7	3	1	0	1
Knowledge	14	5	5	11	5	3	4
	39	8	14	16	7	3	7

Table E.8 Falls - Numbers of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	35.9	7.7	5.1	5.1	2.6	0.0	5.1
Rules	28.2	0.0	17.9	7.7	2.6	0.0	2.6
Knowledge	35.9	12.8	12.8	28.2	12.8	7.7	10.3
	100.0	20.5	35.9	41.0	17.9	7.7	17.9

Table E.9 Falls - Percentages of skill, rule, and knowledge based errors

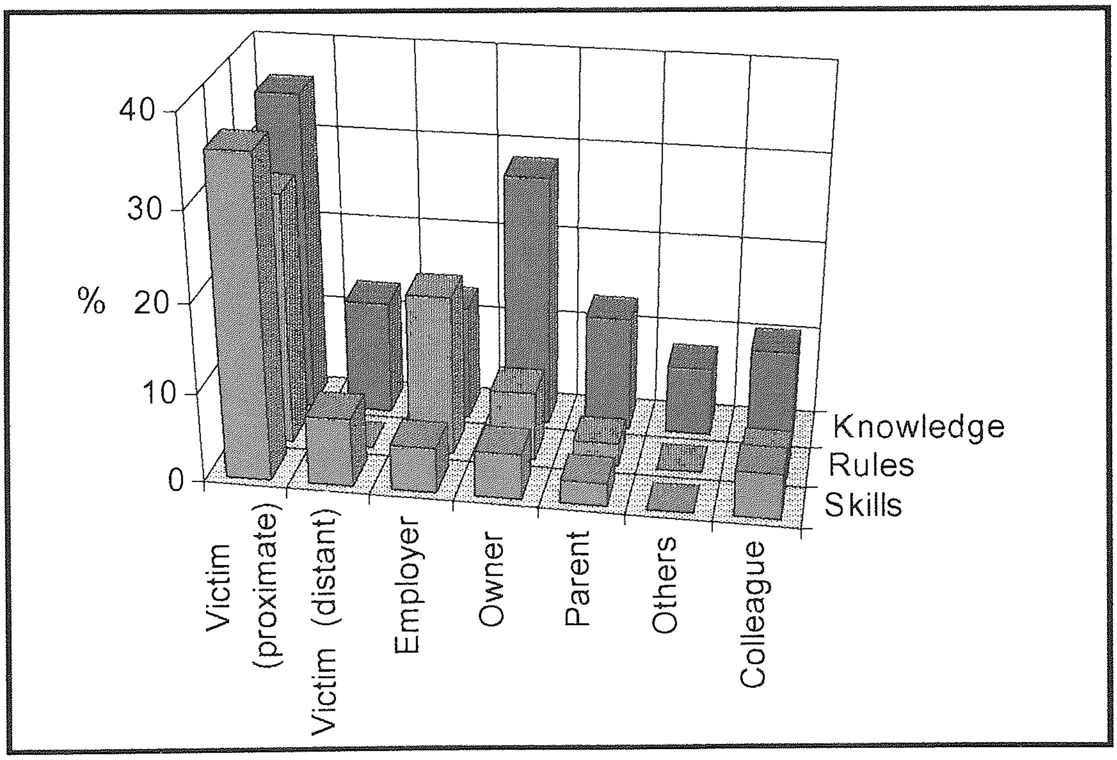


Figure E.2 Falls - Percentages of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	17	5	5	11	5	3	4
Control	22	3	9	5	2	0	3
	39	8	14	16	7	3	7

Table E.10 Falls - Identification/Assessment vs Control failures (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	43.6	12.8	12.8	28.2	12.8	7.7	10.3
Control	56.4	7.7	23.1	12.8	5.1	0.0	7.7
	100.0	20.5	35.9	41.0	17.9	7.7	17.9

Table E.11 Falls - Identification/Assessment vs Control failures (percentage)

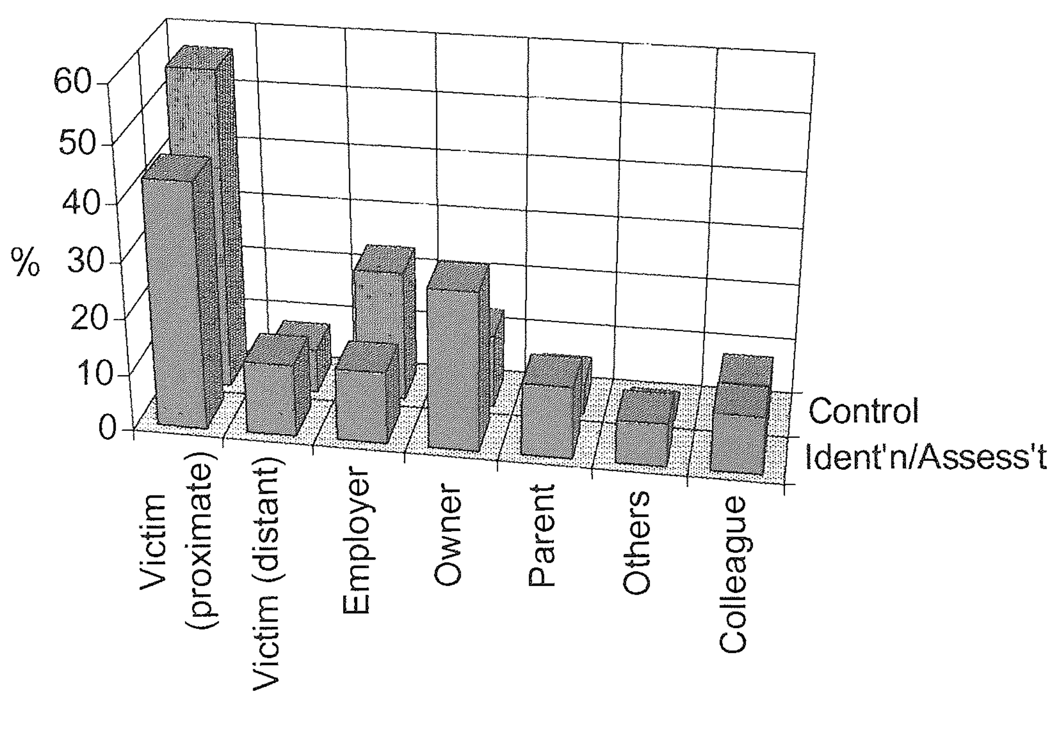


Figure E.3 Falls - Identification/Assessment vs Control failures (percentage)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	14	3	2	2	1	0	2
R - Errors	7	0	1	2	0	0	1
K - Errors	5	0	1	2	1	1	2
Violations	13	5	10	10	5	2	2
	39	8	14	16	7	3	7

Table E.12 Falls - Skill, rule, and knowledge based errors vs Violations (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	35.9	7.7	5.1	5.1	2.6	0.0	5.1
R - Errors	17.9	0.0	2.6	5.1	0.0	0.0	2.6
K - Errors	12.8	0.0	2.6	5.1	2.6	2.6	5.1
Violations	33.3	12.8	25.6	25.6	12.8	5.1	5.1
	100.0	20.5	35.9	41.0	17.9	7.7	17.9

Table E.13 Falls - Skill, rule, and knowledge based errors vs Violations (percentage)

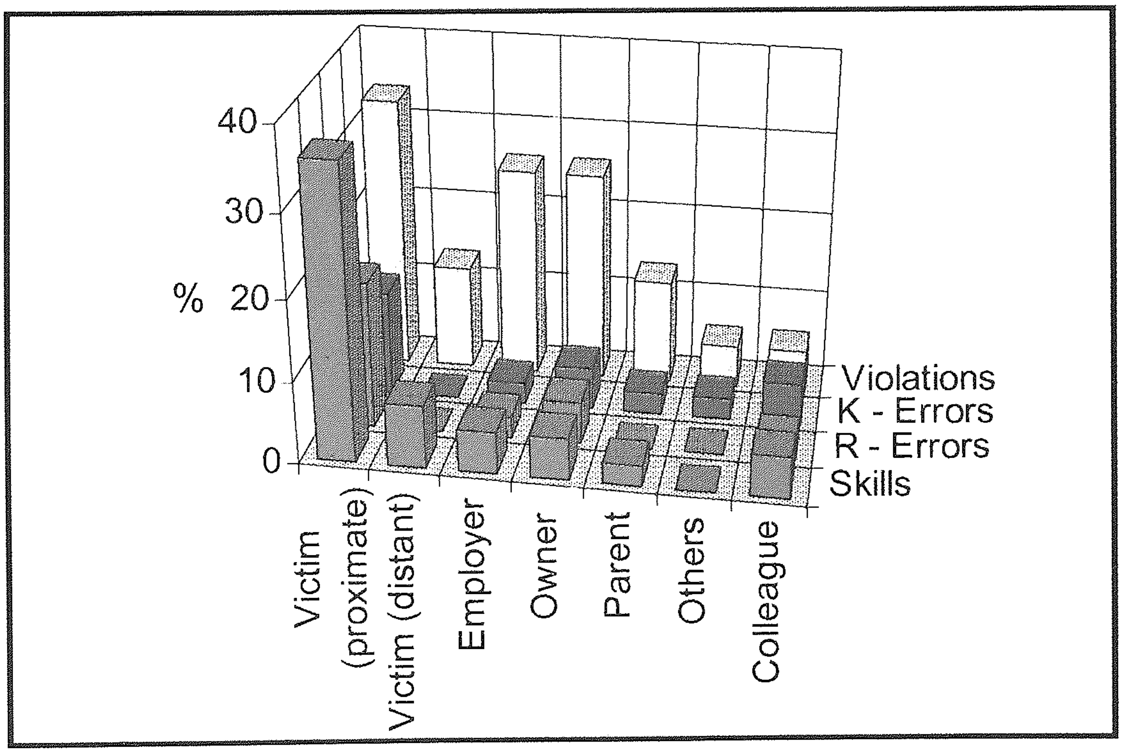


Figure E.4 Falls - Skill, rule, and knowledge based errors vs Violations (percentage)

Data relating to **Transport. (n=61)**

Males 56, Females 5.

Mean age = 39.43, Std Deviation 22.06 years.

Employment status	Full-time	Part-time	Casual	Not employed	Total	
Self employed/family	23	3	1	--	**27**	44.3%
Non employee	--	--	1	12	**13**	21.3%
Employees						
Director/manager/ foreman	2	--	--	--	**2**	3.3%
GFW/tractor driver	15	2	1	--	**18**	29.5%
Mechanic/maintenance worker	--	--	--	--	**0**	0.0%
Lorry driver	--	--	--	--	**0**	0.0%
Stockman/shepherd	--	--	--	--	**0**	0.0%
Contractor	1	--	--	--	**1**	1.6%
Total	**41**	**5**	**3**	**12**	**61**	
	67.2%	8.2%	4.9%	18.7%		

Table F. 1 Transport - Employment status

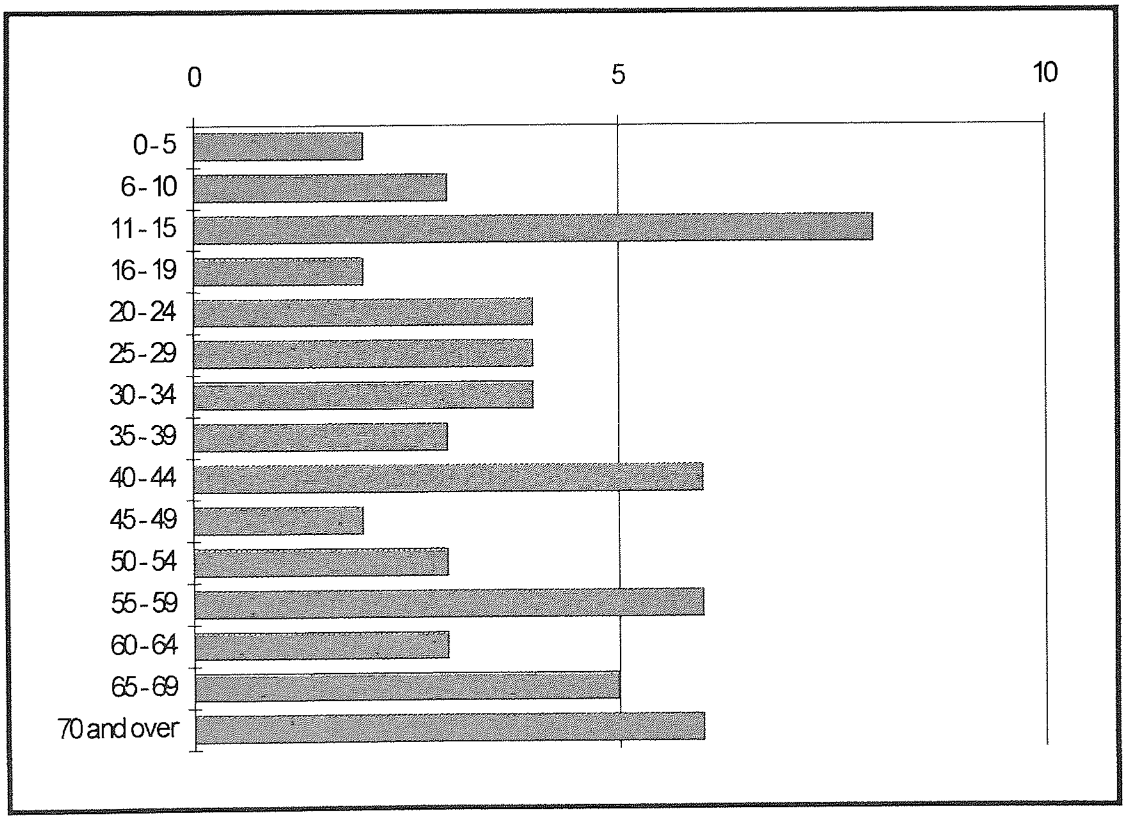


Figure F.1 Transport - Age distribution.

Ages of DP's	Number
Under 16	13
16 - 19	2
20 - 24	4
25 - 29	4
30 - 34	4
35 - 39	3
40 - 44	6
45 - 49	2
50 - 54	3
55 - 59	6
60 -64	3
65 and over	11
Total	61

Table F.2 Transport - Age distribution.

Month	Number
January	2
February	4
March	3
April	5
May	7
June	3
July	6
August	10
September	9
October	6
November	3
December	3
Total	61

Table F.3 Transport - Month

Survival	Number
Died within 24 hrs	52
Survived 1-7 days	6
Survived 8-14 days	1
Survived > 14 days	2
Total	61

Table F.4 Transport - Survival

Kind of accident	Number
Contact with moving machinery	0
Struck by moving object	0
Transport (hit by moving vehicle)	61
Struck against something	0
Injured while handling/lifting /carrying	0
Slip trip or fall on same level	0
Fall - 2 metres or less	0
Fall - over 2 metres	0
Fall - height not known	0
Trapped- collapsing/overturning	0
Drowning or asphyxiation	0
Exposure to harmful substance	0
Exposure to fire	0
Exposure to an explosion	0
Contact with electricity	0
Injured by an animal	0
Other kind of accident	0
Total	61

Table F.5 Kind of accident -Transport

Part of body	Number
Whole body	13
Head	16
Neck/spine	1
Ribs/chest	21
Abdomen	6
Shoulder - elbow	0
Lower arm - wrist	0
Hand - wrist	0
Hip/thigh	1
Lower leg	2
Foot	0
Could not code	1
Total	61

Table F.6 Transport - Site of injury

		Victim (prox'te)	Victim (distant)	Empl'r	Owner of Mach'y/land	Parent	Supplier	Manuf'r	Designer	HSE	Other body eg Utility	Colleague
Skills	Correct response not in programme (A1)	7	--	--	--	--	--	--	--	--	--	--
	Response not correctly executed (E1)	15	--	--	--	--	--	--	--	--	--	2
	Procedure not correctly executed (E3)	8	1	--	--	2	--	--	--	--	--	4
	Plan/procedure not correctly executed (E7)	--	--	1	2	--	--	--	--	--	--	--
Rules	Correct test not chosen, or executed (B6)	--	2	1	--	--	--	--	--	--	--	--
	Correct procedure not known (D2)	7	4	--	2	1	--	--	--	--	--	3
	Correct procedure not chosen (D3)	--	1	--	--	--	--	--	--	--	--	--
	Correct plan/procedure not chosen (D7)	1	2	--	--	--	--	--	--	--	--	1
Knowledge	Responsibility for action not accepted (C3)	12	8	5	8	5	--	--	--	--	--	1
	Need to test, not known/recognised (C4)	10	2	5	2	1	--	--	--	--	--	2
	Responsibility for testing not accepted (C5)	1	--	2	--	--	--	--	--	--	--	1
	Need for action not recognised (C6)	--	1	4	1	--	--	--	--	--	--	2
	Responsibility for action not accepted, allocated (C7)	--	1	--	1	1	--	--	--	--	--	1
		61	22	18	16	10						17

Table F.7 Transport - Distribution of errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	30	1	1	2	2	0	6
Rules	9	9	3	2	1	0	5
Knowledge	22	12	14	12	7	0	6
	61	22	18	16	10	0	17

Table F.8 Transport - Numbers of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	49.2	1.6	1.6	3.3	3.3	0.0	9.8
Rules	14.8	14.8	4.9	3.3	1.6	0.0	8.2
Knowledge	36.1	19.7	23.0	19.7	11.5	0.0	9.8
	100.0	36.1	29.5	26.2	16.4	0.0	27.9

Table F.9 Transport - Percentages of skills, rules, and knowledge based errors

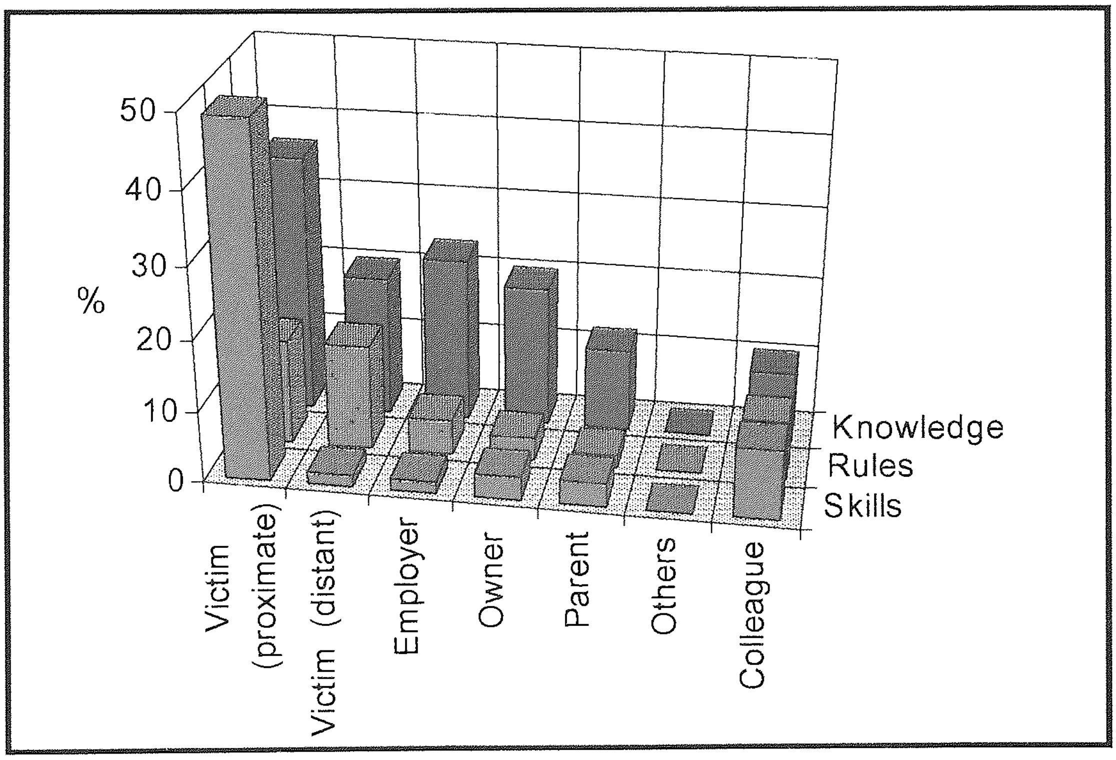


Figure F.2 Transport - Percentages of skills, rules, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	30	14	17	12	7	0	7
Control	31	8	1	4	3	0	10
	61	22	18	16	10	0	17

Table F.10 Transport - Identification/Assessment vs Control failures (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	49.2	23.0	27.9	19.7	11.5	0.0	11.5
Control	50.8	13.2	1.6	6.6	4.9	0.0	16.4
	100.0	36.1	29.5	26.2	16.4	0.0	27.9

Table F.11 Transport - Identification/Assessment vs Control failures (percentage)

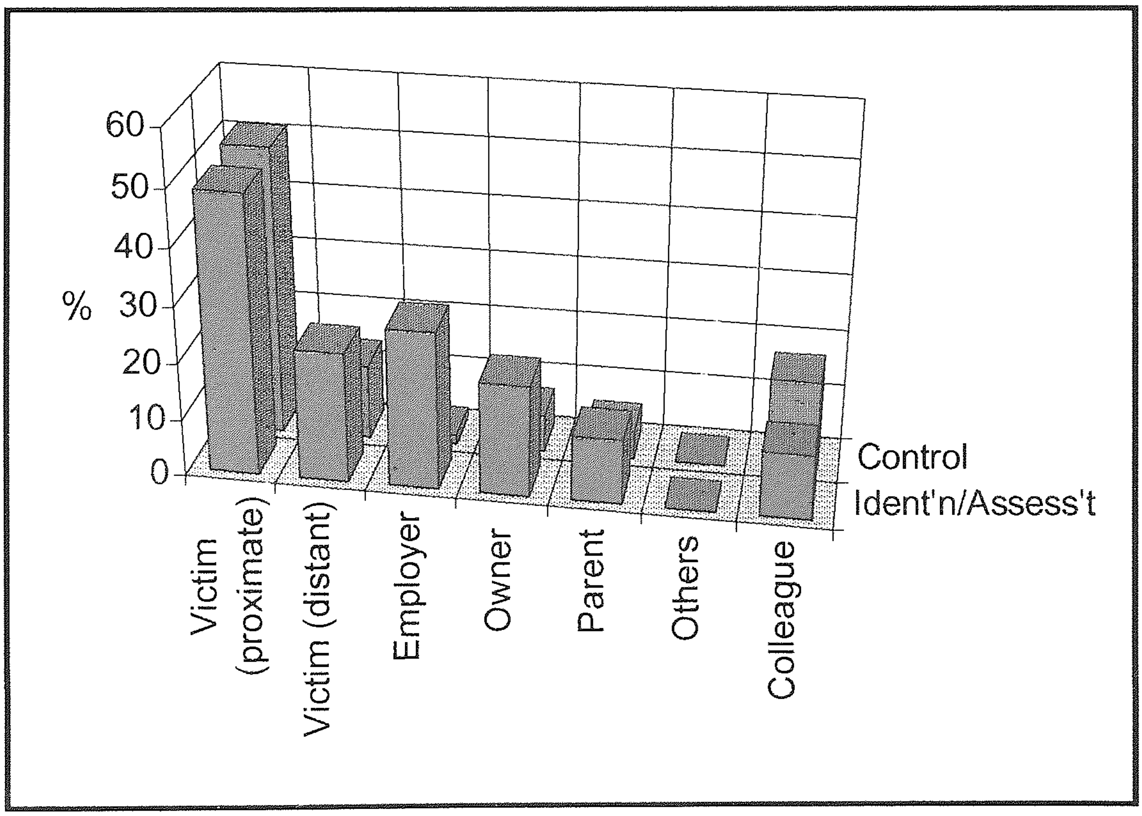


Figure F.3 Transport - Identification/Assessment vs Control failures (percentage)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	30	1	1	2	2	0	6
R - Errors	7	4	0	2	1	0	3
K - Errors	10	3	9	3	1	0	4
Violations	14	14	8	9	6	0	4
	61	22	18	16	10	0	17

Table F.12 Transport - Skill, rule, and knowledge based errors vs Violations (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	49.2	1.6	1.6	3.3	3.3	0.0	9.8
R - Errors	11.5	6.6	0.0	3.3	1.6	0.0	4.9
K - Errors	16.4	4.9	14.8	4.9	1.6	0.0	6.6
Violations	23.0	23.0	13.1	14.8	9.8	0.0	6.6
	100.0	36.1	29.5	26.2	16.4	0.0	27.9

Table F.13 Transport - Skill, rule, and knowledge based errors vs Violations (percentage)

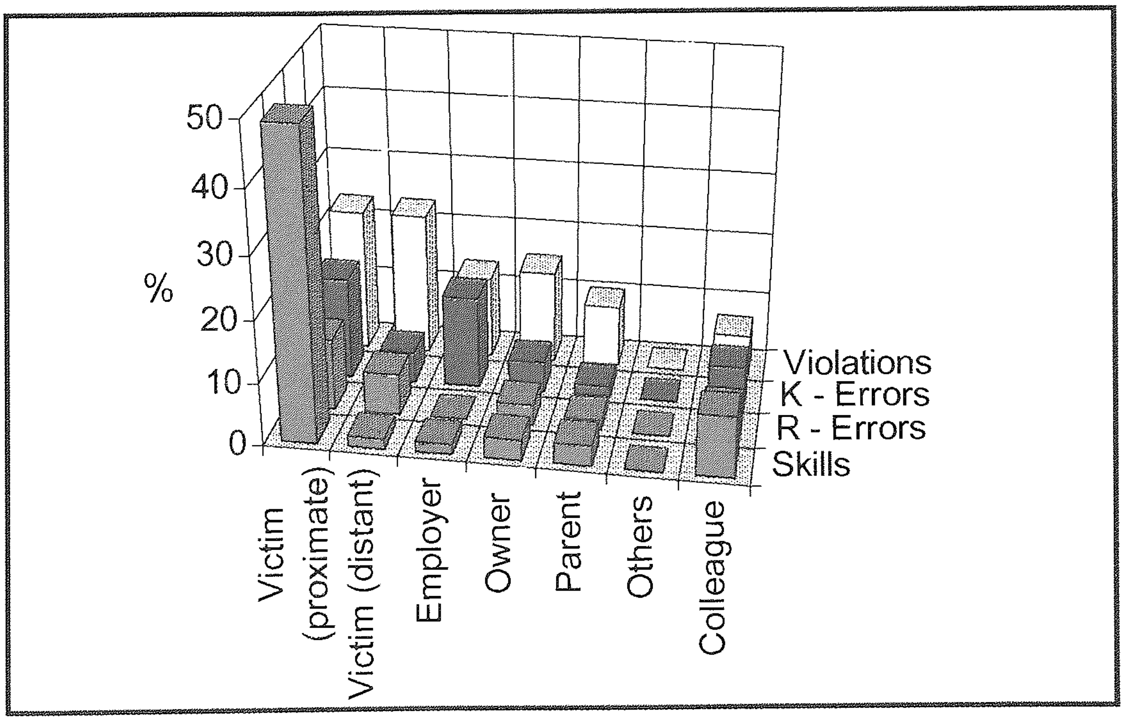


Figure F.4 Transport - Skill, rule, and knowledge based errors vs Violations (percentage)

Data relating to **Struck by. (n=32)**

Males 29, Females 3.

Mean age = 45.31, Std Deviation 17.74 years.

Employment status	Full-time	Part-time	Casual	Not employed	Total	
Self employed/family	12	--	--	--	**12**	37.5%
Non employee	--	--	--	4	**4**	12.5%
Employees						
Director/manager/ foreman	2	--	--	--	**2**	6.3%
GFW/tractor driver	11	1	--	--	**12**	37.5%
Mechanic/maintenance worker	1	--	--	--	**1**	3.1%
Lorry driver	1	--	--	--	**1**	3.1%
Stockman/shepherd	--	--	--	--	**0**	0.0%
Contractor	--	--	--	--	**0**	0.0%
Total	**27**	**1**	**0**	**4**	**32**	
	84.4%	3.1%	0.0%	12.5%		

Table G. 1 Struck by - Employment status

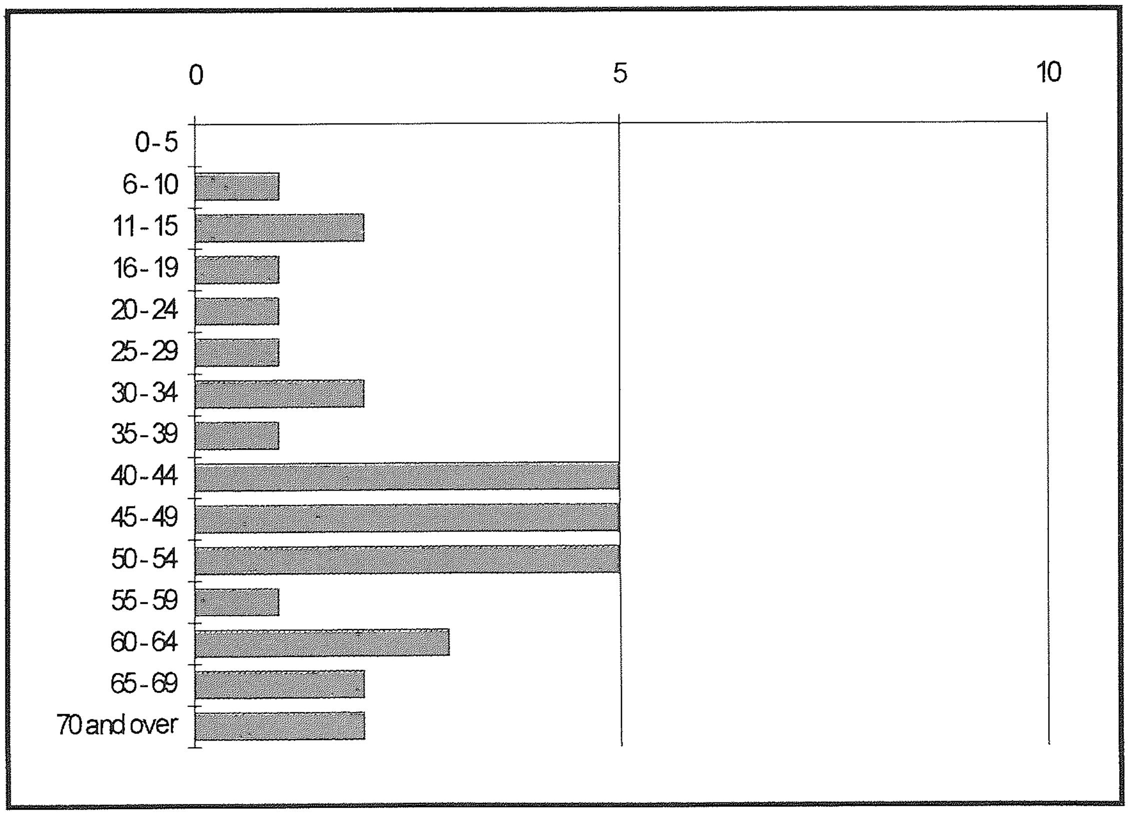


Figure G.1 Struck by - Age distribution.

Ages of DP's	Number
Under 16	3
16 - 19	1
20 - 24	1
25 - 29	1
30 - 34	2
35 - 39	1
40 - 44	5
45 - 49	5
50 - 54	5
55 - 59	1
60 - 64	3
65 and over	4
Total	32

Table G.2 Struck by - Age distribution.

Month	Number
January	6
February	4
March	3
April	3
May	3
June	1
July	1
August	1
September	4
October	1
November	5
December	0
Total	32

Table G.3 Struck by - Month

Survival	Number
Died within 24 hrs	27
Survived 1-7 days	2
Survived 8-14 days	1
Survived > 14 days	2
Total	32

Table G.4 Struck by - Survival

Kind of accident	Number
Contact with moving machinery	0
Struck by moving object	0
Transport (hit by moving vehicle)	0
Struck against something	32
Injured while handling/lifting /carrying	0
Slip trip or fall on same level	0
Fall - 2 metres or less	0
Fall - over 2 metres	0
Fall - height not known	0
Trapped- collapsing/overturning	0
Drowning or asphyxiation	0
Exposure to harmful substance	0
Exposure to fire	0
Exposure to an explosion	0
Contact with electricity	0
Injured by an animal	0
Other kind of accident	0
Total	32

Table G.5 Kind of accident -Struck by

Part of body	Number
Whole body	2
Head	12
Neck/spine	1
Ribs/chest	14
Abdomen	1
Shoulder - elbow	1
Lower arm - wrist	0
Hand - wrist	0
Hip/thigh	0
Lower leg	1
Foot	0
Could not code	0
Total	32

Table G.6 Struck by - Site of injury

		Victim (prox'te)	Victim (distant)	Empl'r	Owner of Mach'y/land	Parent	Supplier	Manuf'r	Designer	HSE	Other body eg Utility	Colleague
Skills	Correct response not in programme (A1)	1	1	--	--	--	--	--	--	--	--	--
	Response not correctly executed (E1)	3	2	--	--	--	--	--	--	--	--	--
	Procedure not correctly executed (E3)	1	--	--	--	--	1	--	--	--	--	1
	Plan/procedure not correctly executed (E7)	1	--	2	--	--	--	--	--	--	--	2
Rules	Correct test not chosen, or executed (B6)	--	--	--	--	--	--	--	--	--	--	--
	Correct procedure not known (D2)	9	--	1	1	--	--	--	--	--	--	5
	Correct procedure not chosen (D3)	2	--	--	1	--	--	--	--	--	--	1
	Correct plan/procedure not chosen (D7)	1	--	--	--	--	--	--	--	--	--	1
Knowledge	Responsibility for action not accepted (C3)	5	2	--	1	1	--	--	--	--	--	3
	Need to test, not known/recognised (C4)	9	3	7	1	--	--	--	--	--	--	5
	Responsibility for testing not accepted (C5)	--	--	3	1	1	--	--	--	--	--	--
	Need for action not recognised (C6)	--	--	2	--	--	--	1	--	--	--	--
	Responsibility for action not accepted, allocated (C7)	--	--	--	--	--	--	--	--	--	--	--
		32	8	15	5	2	1	1				18

Table G.7 Struck by - Distribution of errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other eg Manufacturer supplier, utility	Colleague
Skills	6	3	2	0	0	1	3
Rules	12	0	4	3	1	0	7
Knowledge	14	5	9	2	1	1	8
	32	8	15	5	2	2	18

Table G.8 Struck by - Numbers of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other eg Manufacturer supplier, utility	Colleague
Skills	18.8	9.4	6.3	0.0	0.0	3.1	9.4
Rules	37.5	0.0	12.5	9.4	3.1	0.0	21.9
Knowledge	43.8	15.6	28.1	6.3	3.1	3.1	25.0
	100.0	25.0	46.9	15.6	6.3	6.3	56.3

Table G.9 Struck by - Percentages of skill, rule, and knowledge based errors

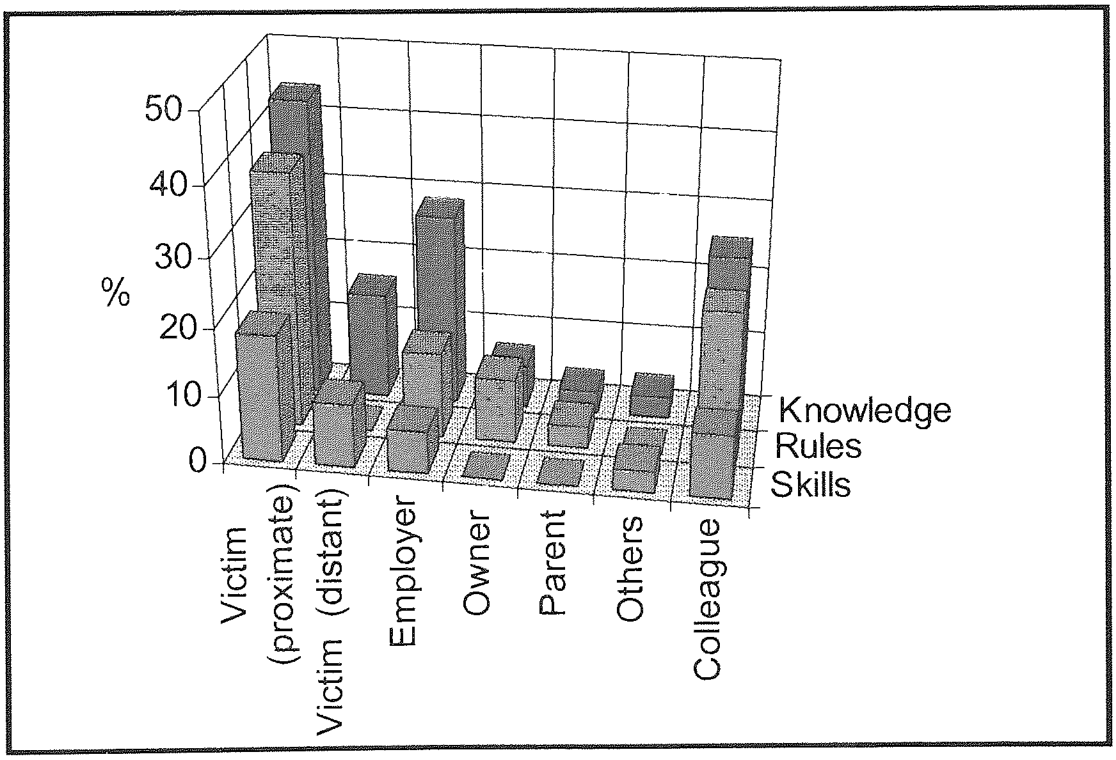


Figure G.2 Struck by - Percentages of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other eg Manufacturer supplier, utility	Colleague
Identification/ Assessment	15	6	12	3	2	1	8
Control	17	2	3	2	0	1	10
	32	8	15	5	2	2	18

Table G.10 Struck by - Identification/Assessment vs Control failures (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other eg Manufacturer supplier, utility	Colleague
Identification/ Assessment	46.9	18.8	37.5	9.4	6.3	3.1	25.0
Control	53.1	6.3	9.4	6.3	0.0	3.1	31.3
	100.0	25.0	46.9	15.6	6.3	6.3	56.3

Table G.11 Struck by - Identification/Assessment vs Control failures (percentage)

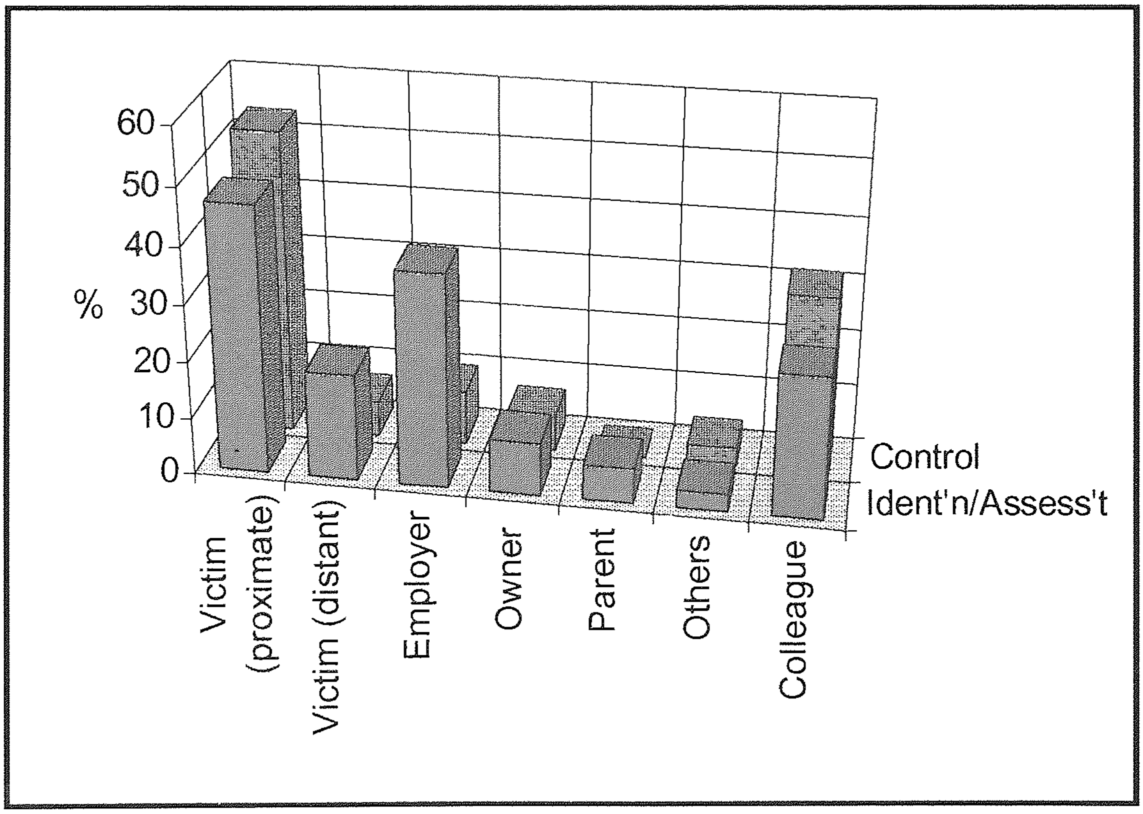


Figure G.3 Struck by - Identification/Assessment vs Control failures (percentage)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	6	3	2	0	0	1	3
R - Errors	9	0	1	1	0	0	5
K - Errors	9	3	9	1	0	1	5
Violations	8	2	3	3	2	0	5
	32	8	15	5	2	2	18

Table G.12 Struck by - Skill, rule, and knowledge based errors vs Violations (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other eg Manufacturer supplier, utility	Colleague
Skills	18.8	9.4	6.3	0.0	0.0	3.1	9.4
R - Errors	28.1	0.0	3.1	3.1	0.0	0.0	15.6
K - Errors	28.1	9.4	28.1	3.1	0.0	3.1	15.6
Violations	25.0	6.3	9.4	9.4	6.3	0.0	15.6
	100.0	25.0	46.9	15.6	6.3	6.3	56.3

Table G.13 Struck by - Skill, rule, and knowledge based errors vs Violations (percentage)

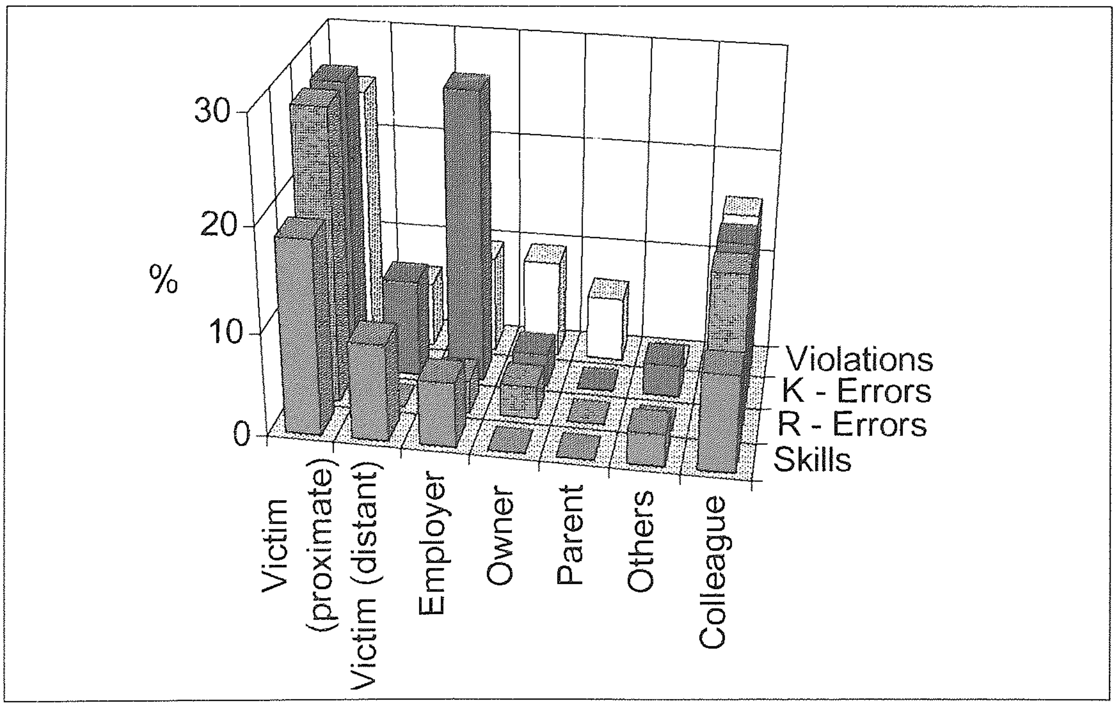


Figure G.4 Struck by - Skill, rule, and knowledge based errors vs Violations (percentage)

Data relating to **Matrix cell C4. (n=59)**

Males 29, Females 3.

Mean age = 45.31, Std Deviation 17.74 years.

Employment status	Full-time	Part-time	Casual	Not employed	Total	
Self employed/family	16	1	1	1	**19**	32.2%
Non employee	--	--	--	23	**23**	39.0%
Employees						
Director/manager/ foreman	--	--	--	--	**0**	0.0%
GFW/tractor driver	14	--	1	--	**15**	25.4%
Mechanic/maintenance worker	--	--	--	--	**0**	0.0%
Lorry driver	1	--	--	--	**1**	1.7%
Stockman/shepherd	1	--	--	--	**1**	1.7%
Contractor	--	--	--	--	**0**	0.0%
Total	**32**	**1**	**2**	**24**	**59**	
	54.2%	1.7%	3.4%	40.7%		

Table H. 1 Matrix cell C4 - Employment status

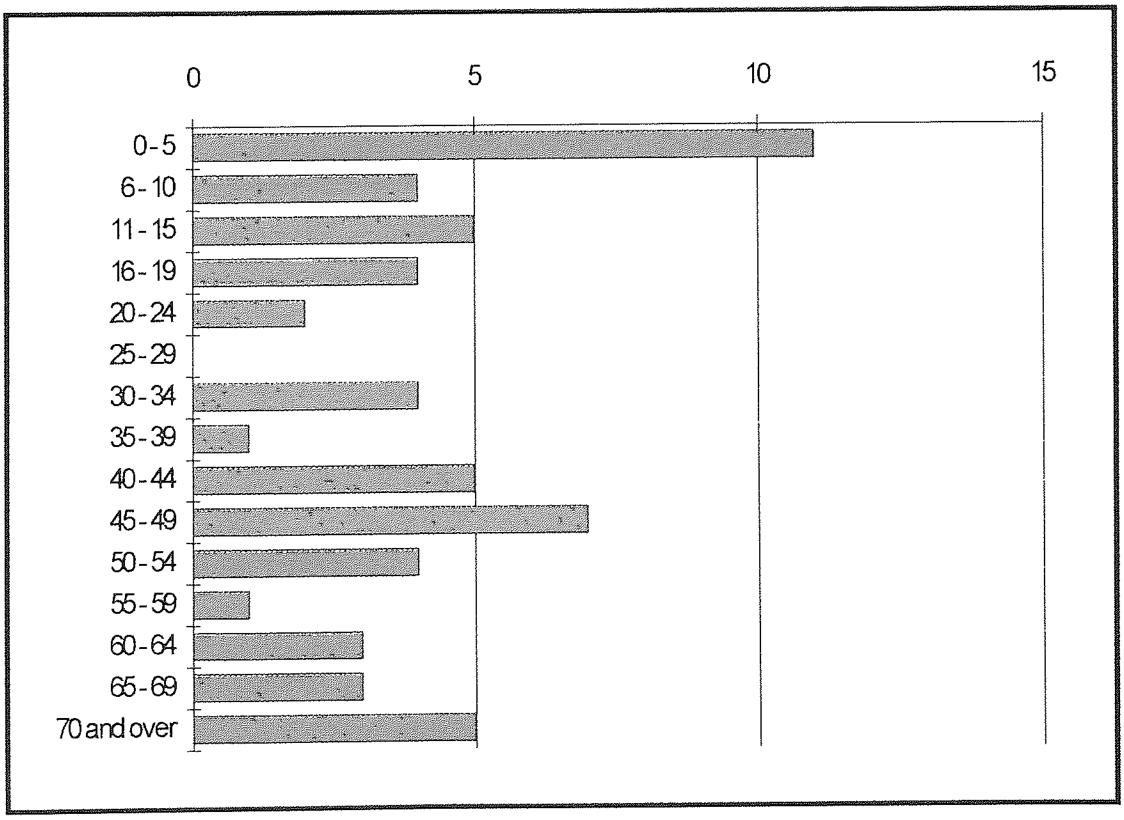


Figure H.1 Matrix cell C4 - Age

Ages of DP's	Number
Under 16	20
16 - 19	4
20 - 24	2
25 - 29	0
30 - 34	4
35 - 39	1
40 - 44	5
45 - 49	7
50 - 54	4
55 - 59	1
60 - 64	3
65 and over	8
Total	**59**

Table H.2 Matrix cell C4 - Age

Month	Number
January	5
February	2
March	4
April	9
May	8
June	1
July	5
August	6
September	9
October	3
November	2
December	5
Total	**59**

Table H.3 Matrix cell C4 - Month

Survival	Number
Died within 24 hrs	48
Survived 1-7 days	4
Survived 8-14 days	1
Survived > 14 days	6
Total	**59**

Table H.4 Matrix cell C4 - Survival

Kind of accident	Number
Contact with moving machinery	6
Struck by moving object	9
Transport (hit by moving vehicle)	10
Struck against something	1
Injured while handling/lifting /carrying	0
Slip trip or fall on same level	1
Fall - 2 metres or less	5
Fall - over 2 metres	0
Fall - height not known	0
Trapped- collapsing/overturning	1
Drowning or asphyxiation	11
Exposure to harmful substance	1
Exposure to fire	0
Exposure to an explosion	0
Contact with electricity	8
Injured by an animal	6
Other kind of accident	0
Total	**59**

Table H.5 Matrix cell C4 - Kind of accident

Part of body	Number
Whole body	14
Head	9
Neck/spine	5
Ribs/chest	23
Abdomen	3
Shoulder - elbow	0
Lower arm - wrist	0
Hand - wrist	0
Hip/thigh	2
Lower leg	1
Foot	2
Could not code	0
Total	**59**

Table H.6 Matrix cell C4 - Site of injury

		Victim (prox'te)	Victim (distant)	Empl'r	Owner of Mach'y/land	Parent	Supplier	Manuf'r	Designer	HSE	Other body e.g. Utility	Colleague
Skills	Correct response not in programme (A1)	--	--	--	--	--	--	--	--	--	--	--
	Response not correctly executed (E1)	--	--	--	1	--	--	--	--	--	--	--
	Procedure not correctly executed (E3)	--	--	2	1	1	--	--	--	--	--	1
	Plan/procedure not correctly executed (E7)	--	--	1	3	1	--	1	--	1	--	1
Rules	Correct test not chosen, or executed (B6)	--	--	--	--	1	--	--	--	--	--	--
	Correct procedure not known	---	3	--	5	2	--	--	--	--	--	1
	Correct procedure not chosen (D3)	--	--	--	1	1	--	--	--	--	--	1
	Correct plan/procedure not chosen (D7)	--	--	--	2	2	--	--	--	--	--	--
Knowledge	Responsibility for action not accepted (C3)	--	2	1	7	5	2	--	--	--	--	1
	Need to test, not known/recognised (C4)	59	--	10	4	2	1	--	--	--	--	10
	Responsibility for testing not accepted (C5)	--	--	1	1	1	--	--	--	--	--	--
	Need for action not recognised (C6)	--	--	2	1	2	1	1	--	--	--	--
	Responsibility for action not accepted, allocated (C7)	--	--	--	1	--	--	1	--	--	--	--
		59	5	17	27	18	4	3		1		15

Table H.7 Matrix cell C4 - Distribution of errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	0	0	3	5	2	2	2
Rules	0	3	0	8	6	0	2
Knowledge	59	2	14	14	10	6	11
	59	5	17	27	18	8	18

Table H.8 Matrix cell C4 - Numbers of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	0.0	0.0	5.1	8.5	3.4	3.4	3.4
Rules	0.0	5.1	0.0	13.6	10.2	0.0	3.4
Knowledge	100.0	3.4	23.7	23.7	16.9	10.2	18.6
	100.0	8.5	28.8	45.8	30.5	13.6	25.4

Table H.9 Matrix cell C4 - Percentages of skill, rule, and knowledge based errors

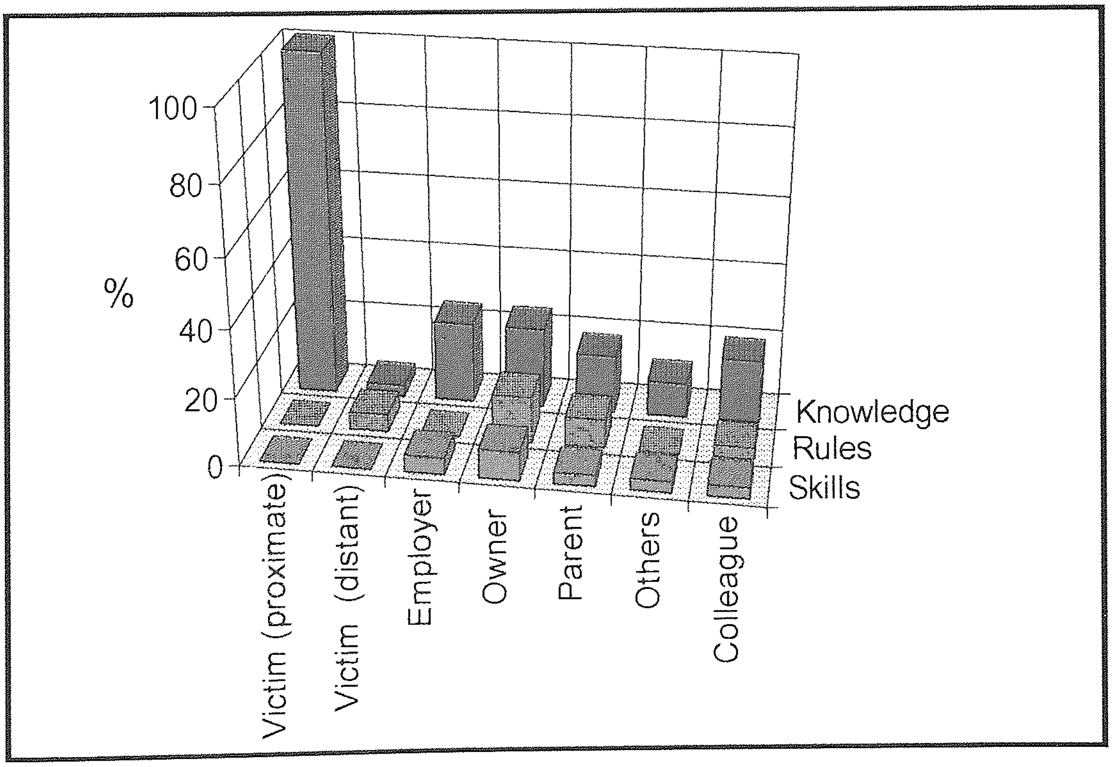


Figure H.2 Matrix cell C4 - Percentages of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	59	2	14	14	11	6	11
Control	0	3	3	13	7	2	4
	59	5	17	27	18	8	15

Table H.10 Matrix cell C4 - Identification/Assessment vs Control failures (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	100.0	3.4	23.7	23.7	18.6	10.2	18.6
Control	0.0	5.1	5.1	22.0	11.9	3.4	6.8
	100.0	8.5	28.8	45.8	30.5	13.6	25.4

Table H.11 Matrix cell C4 - Identification/Assessment vs Control failures (percentage)

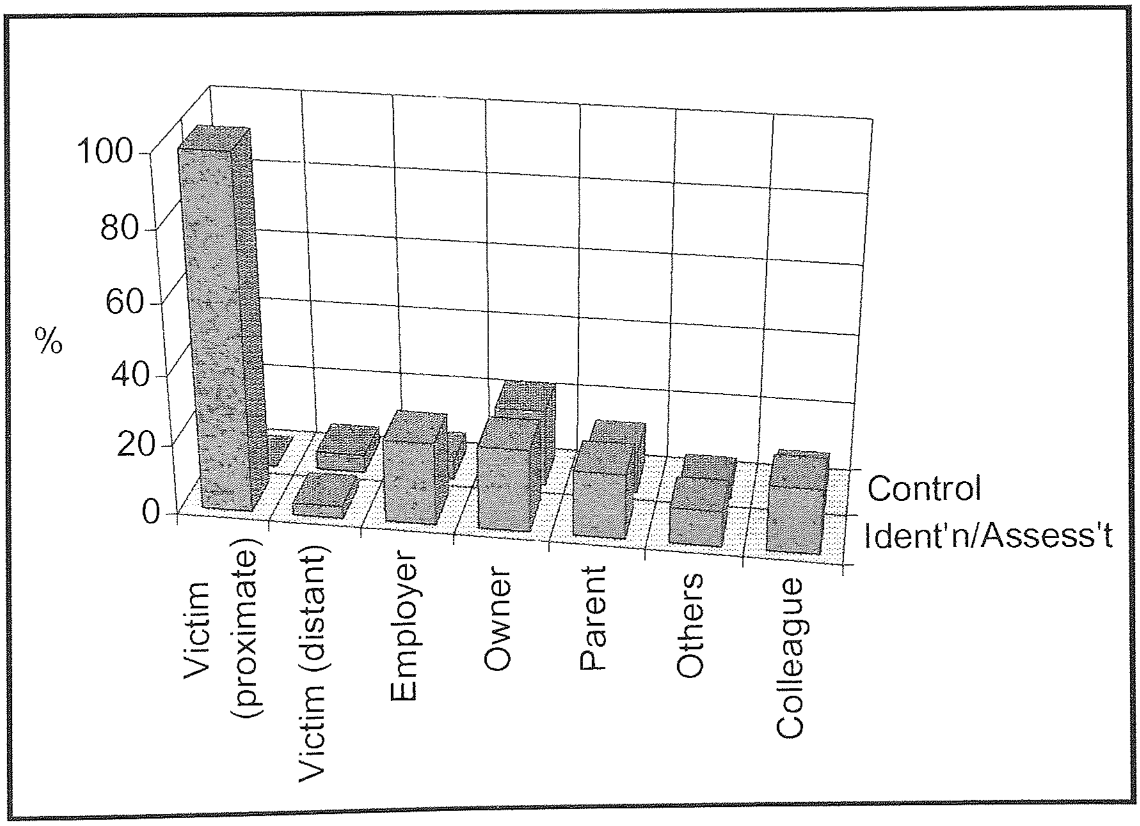


Figure H.3 Matrix cell C4 - Identification/Assessment vs Control failures

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	0	0	3	5	2	2	2
R - Errors	0	3	0	5	2	0	1
K - Errors	59	0	12	5	4	3	10
Violations	0	2	2	12	10	3	2
	59	5	17	27	18	8	15

Table H.12 Matrix cell C4 - Skill, rule, and knowledge based errors vs Violations (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	0.0	0.0	5.1	8.5	3.4	3.4	3.4
R - Errors	0.0	5.1	0.0	8.5	3.4	0.0	1.7
K - Errors	100.0	0.0	20.3	8.5	6.8	5.1	16.9
Violations	0.0	3.4	3.4	20.3	16.9	5.1	3.4
	100.0	8.5	28.8	45.8	30.5	13.6	25.4

Table H.13 Matrix cell C4 - Skill, rule, and knowledge based errors vs Violations (percentage)

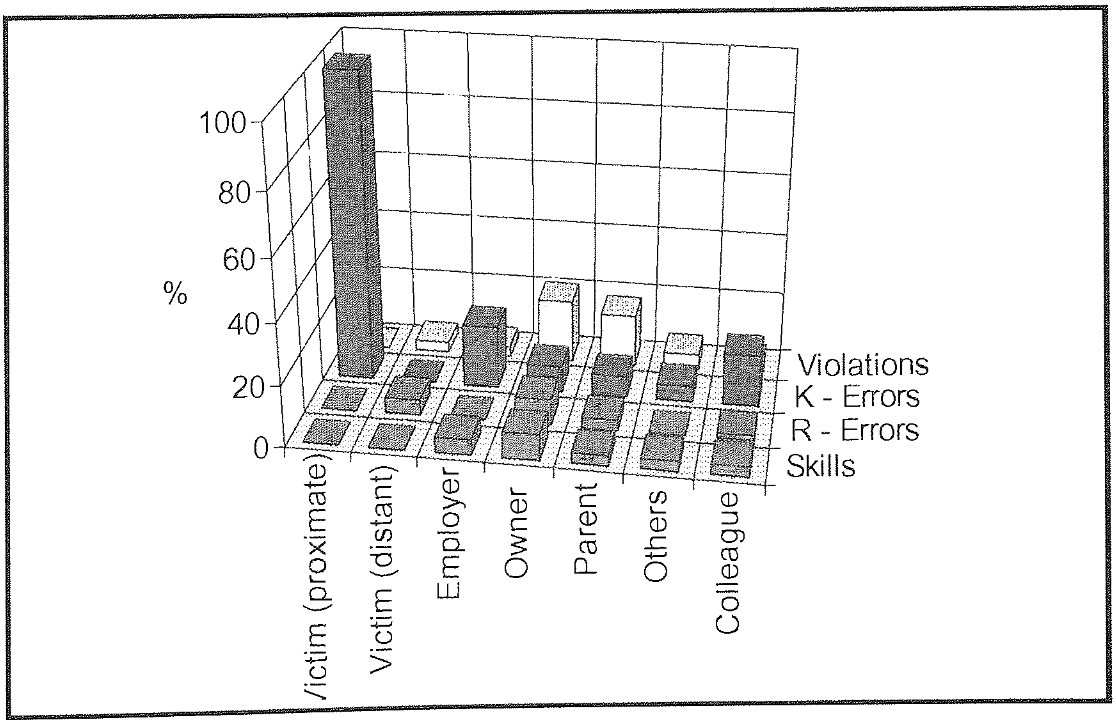


Figure H.4 Matrix cell C4 - Skill, rule, and knowledge based errors vs Violations

Data relating to **Matrix cell D2. (n=37)**

Males 36, Females 1.

Mean age = 39.35, Std Deviation 21.12 years.

Employment status	Full-time	Part-time	Casual	Not employed	Total	
Self employed/family	17	--	2	--	**19**	51.4%
Non employee	--	--	--	6	**6**	16.2%
Employees						
Director/manager/ foreman	2	--	--	--	**2**	5.4%
GFW/tractor driver	8	1	--	--	**9**	24.3%
Mechanic/maintenance worker	1	--	--	--	**1**	2.7%
Lorry driver	--	--	--	--	**0**	0.0%
Stockman/shepherd	--	--	--	--	**0**	0.0%
Contractor	--	--	--	--	**0**	0.0%
Total	28	1	2	6	37	
	75.7%	2.7%	5.4%	16.2%		

Table I. 1 Matrix cell D2 - Employment status

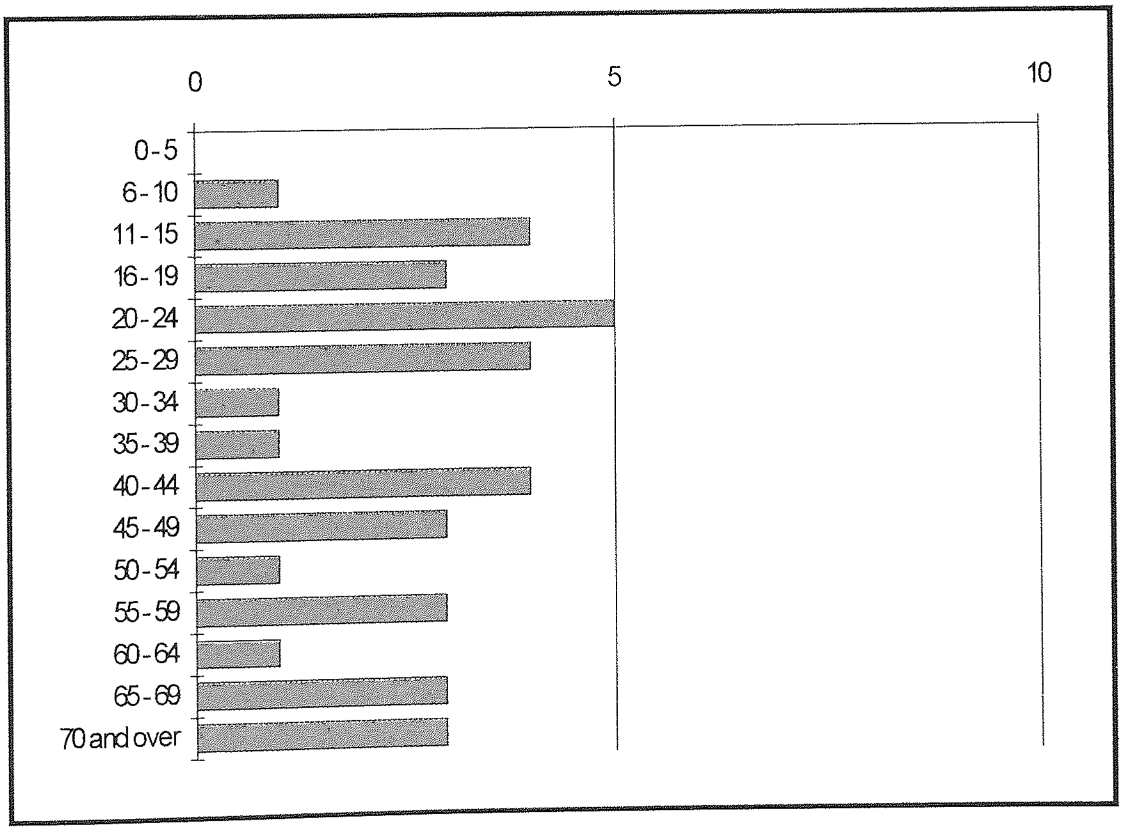


Figure I.1 Matrix cell D2 - Age

Ages of DP's	Number
Under 16	5
16 - 19	3
20 - 24	5
25 - 29	4
30 - 34	1
35 - 39	1
40 - 44	4
45 - 49	3
50 - 54	1
55 - 59	3
60 - 64	1
65 and over	6
Total	37

Table I.2 Matrix cell D2 - Age

Month	Number
January	4
February	3
March	1
April	2
May	2
June	4
July	1
August	7
September	6
October	1
November	5
December	1
Total	37

Table I.3 Matrix cell D2 - Month

Survival	Number
Died within 24 hrs	29
Survived 1-7 days	5
Survived 8-14 days	2
Survived > 14 days	1
Total	37

Table I.4 Matrix cell D2 - Survival

Kind of accident	Number
Contact with moving machinery	4
Struck by moving object	9
Transport (hit by moving vehicle)	7
Struck against something	0
Injured while handling/lifting /carrying	0
Slip trip or fall on same level	0
Fall - 2 metres or less	2
Fall - over 2 metres	5
Fall - height not known	0
Trapped- collapsing/overturning	2
Drowning or asphyxiation	3
Exposure to harmful substance	0
Exposure to fire	2
Exposure to an explosion	0
Contact with electricity	2
Injured by an animal	1
Other kind of accident	0
Total	37

Table I.5 Matrix cell D2 - Kind of accident

Part of body	Number
Whole body	10
Head	7
Neck/spine	5
Ribs/chest	11
Abdomen	2
Shoulder - elbow	1
Lower arm - wrist	0
Hand - wrist	0
Hip/thigh	0
Lower leg	1
Foot	0
Could not code	0
Total	37

Table I.6 Matrix cell D2 - Site of injury

		Victim (prox'te)	Victim (distant)	Empl'r	Owner of Mach'y/lan	Parent	Supplier	Manuf'r	Designer	HSE	Other body e.g. Utility	Colleague
Skills	Correct response not in programme (A1)	--	1	--	--	--	--	--	--	--	--	--
	Response not correctly executed (E1)	--	2	--	--	--	--	--	--	--	--	--
	Procedure not correctly executed (E3)	--	--	--	1	1	1	--	--	--	--	--
	Plan/procedure not correctly executed (E7)	--	--	--	--	--	--	--	--	--	--	--
Rules	Correct test not chosen, or executed (B6)	--	--	2	--	--	--	2	--	--	--	--
	Correct procedure not known (D2)	37	--	2	3	2	--	--	--	--	--	15
	Correct procedure not chosen (D3)	--	--	--	1	--	--	--	--	--	--	--
	Correct plan/procedure not chosen (D7)	--	--	1	--	--	--	--	1	--	--	--
Knowledge	Responsibility for action not accepted (C3)	--	1	1	2	--	1	1	--	--	--	2
	Need to test, not known/recognised (C4)	--	--	2	1	--	1	--	--	--	--	2
	Responsibility for testing not accepted (C5)	--	--	2	--	--	--	--	--	--	--	--
	Need for action not recognised (C6)	--	--	4	--	--	--	--	--	--	--	--
	Responsibility for action not accepted, allocated (C7)	--	--	1	1	1	--	--	--	--	--	--
		37	**4**	**15**	**9**	**4**	**3**	**3**	**1**			**19**

Table I. 7 Matrix cell D2 - Distribution of errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	0	3	0	1	1	1	0
Rules	37	0	5	4	2	3	15
Knowledge	0	1	10	4	1	3	4
	37	4	15	9	4	7	19

Table I.8 Matrix cell D2 - Numbers of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	0.0	8.1	0.0	2.7	2.7	2.7	0.0
Rules	100.0	0.0	13.5	10.8	5.4	8.1	40.5
Knowledge	0.0	2.7	27.0	10.8	2.7	8.1	10.8
	100.0	10.8	40.5	24.3	10.8	18.9	51.4

Table I.9 Matrix cell D2 - Percentages of skill, rule, and knowledge based errors

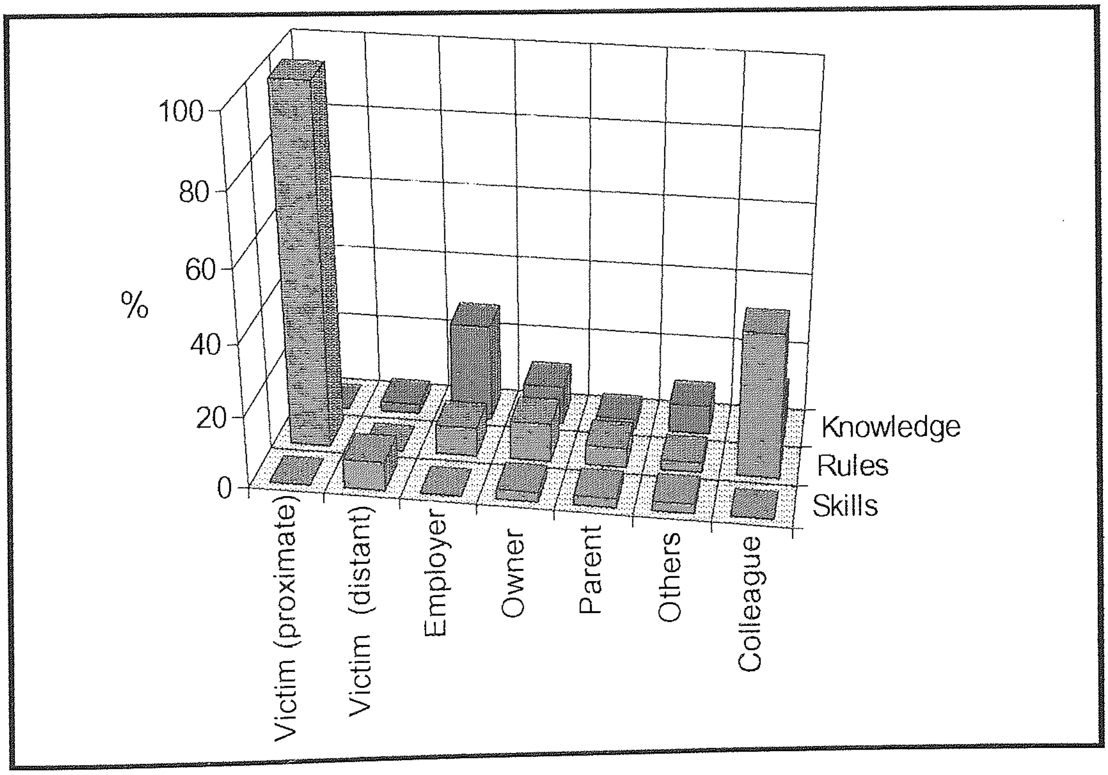


Figure I.2 Matrix cell D2 - Percentages of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	0	2	12	4	1	5	4
Control	37	2	3	5	3	2	15
	37	4	15	9	4	7	19

Table I.10 Matrix cell D2 - Identification/Assessment vs Control failures (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	0.0	5.4	32.4	10.8	2.7	13.5	10.8
Control	100.0	5.4	8.1	13.5	8.1	5.4	40.5
	100.0	10.8	40.5	24.3	10.8	18.9	51.4

Table I.11 Matrix cell D2 - Identification/Assessment vs Control failures (percentage)

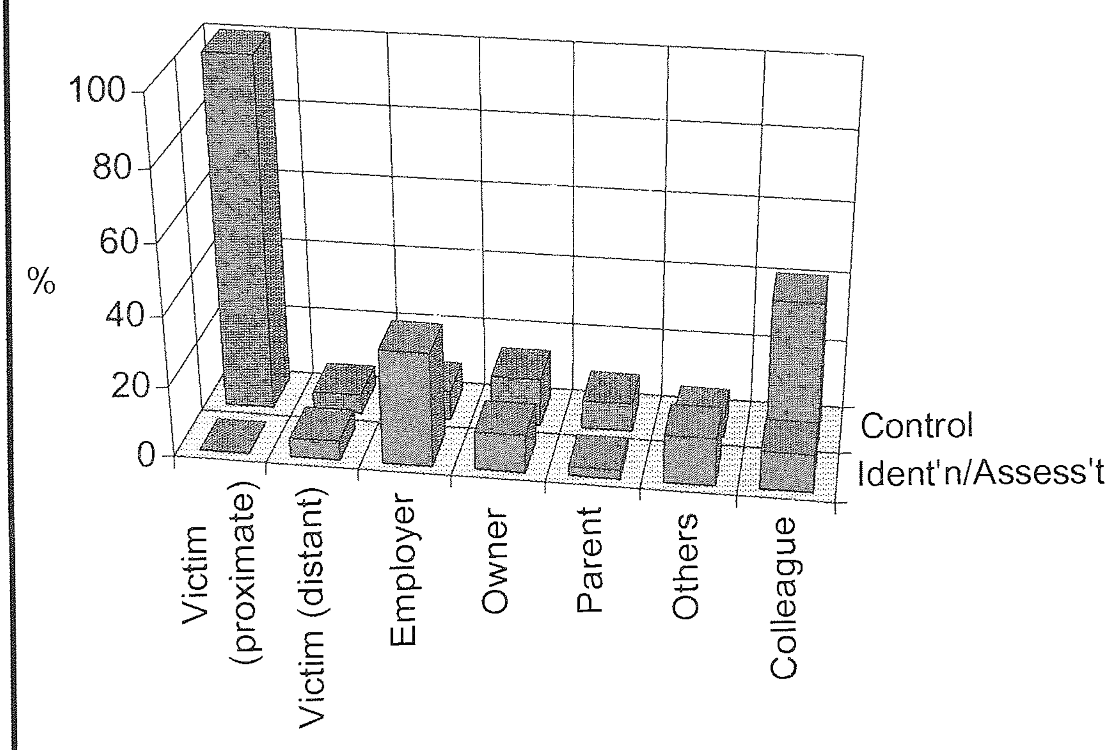


Figure I.3 Matrix cell D2 - Identification/Assessment vs Control failures

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	0	3	0	1	1	1	0
R - Errors	37	0	2	3	2	0	15
K - Errors	0	0	6	1	0	1	2
Violations	0	1	7	4	1	5	2
	37	4	15	9	4	7	19

Table I.12 Matrix cell D2 - Skill, rule, and knowledge based errors vs Violations (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	0.0	8.1	0.0	2.7	2.7	2.7	0.0
R - Errors	100.0	0.0	5.4	8.1	5.4	0.0	40.5
K - Errors	0.0	0.0	16.2	2.7	0.0	2.7	5.4
Violations	0.0	2.7	18.9	10.8	2.7	13.5	5.4
	100.0	10.8	40.5	24.3	10.8	18.9	51.4

Table I.13 Matrix cell D2 - Skill, rule, and knowledge based errors vs Violations (percentage)

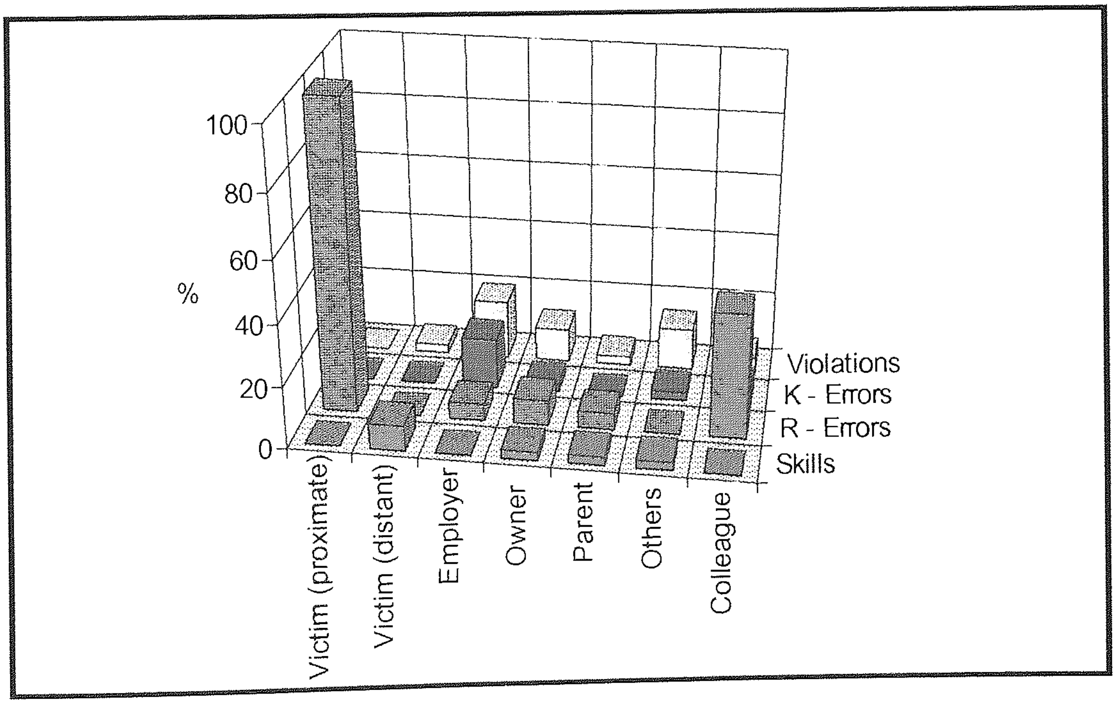


Figure I.4 Matrix cell D2 - Skill, rule, and knowledge based errors vs Violations

Data relating to **Matrix cell E1. (n=38)**

Males 32, Females 6.

Mean age = 47.68, Std Deviation 21.51 years.

Employment status	Full-time	Part-time	Casual	Not employed	Total	
Self employed/family	11	2	--	--	**13**	34.2%
Non employee	--	--	--	7	**7**	18.4%
<u>Employees</u>						
Director/manager/ foreman	2	--	--	--	**2**	5.3%
GFW/tractor driver	11	3	1	--	**15**	39.5%
Mechanic/maintenance worker	--	--	--	--	**0**	0.0%
Lorry driver	--	--	--	--	**0**	0.0%
Stockman/shepherd	--	--	--	--	**0**	0.0%
Contractor	1	--	--	--	**1**	2.6%
Total	**25**	**5**	**1**	**7**	**38**	
	65.8%	13.2%	2.6%	18.4%		

Table J. 1 Matrix cell E1 - Employment status

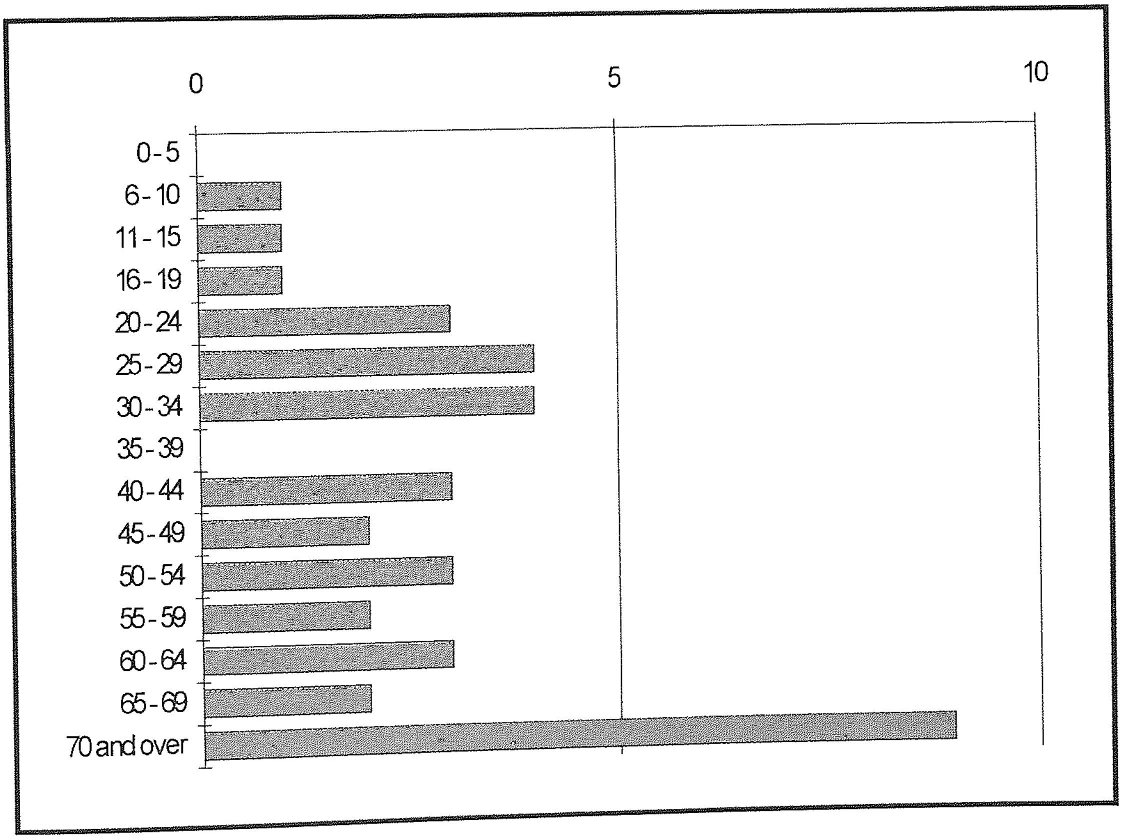


Figure J.1 Matrix cell E1 - Age

Ages of DP's	Number
Under 16	2
16 - 19	1
20 - 24	3
25 - 29	4
30 - 34	4
35 - 39	0
40 - 44	3
45 - 49	2
50 - 54	3
55 - 59	2
60 - 64	3
65 and over	11
Total	**38**

Table J.2 Matrix cell E1 - Age

Month	Number
January	3
February	3
March	2
April	0
May	1
June	3
July	6
August	6
September	4
October	6
November	3
December	1
Total	**38**

Table J.3 Matrix cell E1 - Month

Survival	Number
Died within 24 hrs	29
Survived 1-7 days	5
Survived 8-14 days	2
Survived > 14 days	2
Total	**38**

Table J.4 Matrix cell E1 - Survival

Kind of accident	Number
Contact with moving machinery	4
Struck by moving object	3
Transport (hit by moving vehicle)	15
Struck against something	0
Injured while handling/lifting /carrying	0
Slip trip or fall on same level	2
Fall - 2 metres or less	6
Fall - over 2 metres	2
Fall - height not known	0
Trapped- collapsing/overturning	2
Drowning or asphyxiation	0
Exposure to harmful substance	0
Exposure to fire	0
Exposure to an explosion	0
Contact with electricity	0
Injured by an animal	4
Other kind of accident	0
Total	**38**

Table J.5 Matrix cell E1 - Kind of accident

Part of body	Number
Whole body	6
Head	14
Neck/spine	3
Ribs/chest	9
Abdomen	2
Shoulder - elbow	1
Lower arm - wrist	0
Hand - wrist	0
Hip/thigh	1
Lower leg	1
Foot	0
Could not code	1
Total	**38**

Table J.6 Matrix cell E1 - Site of injury

		Victim (prox'te)	Victim (distant)	Empl'r	Owner of Mach'y/land	Parent	Supplier	Manuf'r	Designer	HSE	Other body e.g. Utility	Colleague
Skills	Correct response not in programme (A1)	--	--	--	--	--	--	--	--	--	--	--
	Response not correctly executed (E1)	38	--	--	--	--	--	--	--	--	--	1
	Procedure not correctly executed (E3)	--	4	1	1	1	1	--	--	--	--	4
	Plan/procedure not correctly executed (E7)	--	--	1	--	--	--	--	--	--	--	--
Rules	Correct test not chosen, or executed (B6)	--	1	1	--	--	--	--	--	--	--	--
	Correct procedure not known (D2)	--	2	--	1	--	--	--	--	--	--	1
	Correct procedure not chosen (D3)	--	--	--	--	--	--	--	--	--	--	--
	Correct plan/procedure not chosen (D7)	--	4	2	--	--	--	--	--	--	--	2
Knowledge	Responsibility for action not accepted (C3)	--	12	4	4	--	--	--	--	--	--	3
	Need to test, not known/recognised (C4)	--	1	4	2	--	--	--	--	--	--	--
	Responsibility for testing not accepted (C5)	--	--	--	1	--	--	--	--	--	--	--
	Need for action not recognised (C6)	--	--	1	--	--	--	--	--	--	--	--
	Responsibility for action not accepted, allocated (C7)	--	1	--	--	--	--	--	--	--	--	1
		38	25	14	9	1	1					12

Table J. 7 Matrix cell E1 - Distribution of errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	38	4	2	1	1	1	5
Rules	0	7	3	1	0	0	3
Knowledge	0	14	9	7	0	0	4
	38	25	14	9	1	1	12

Table J.8 Matrix cell E1 - Numbers of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	100.0	10.5	5.3	2.6	2.6	2.6	13.2
Rules	0.0	18.4	7.9	2.6	0.0	0.0	7.9
Knowledge	0.0	36.8	23.7	18.4	0.0	0.0	10.5
	100.0	65.8	36.8	23.7	2.6	2.6	31.6

Table J.9 Matrix cell E1 - Percentages of skill, rule, and knowledge based errors

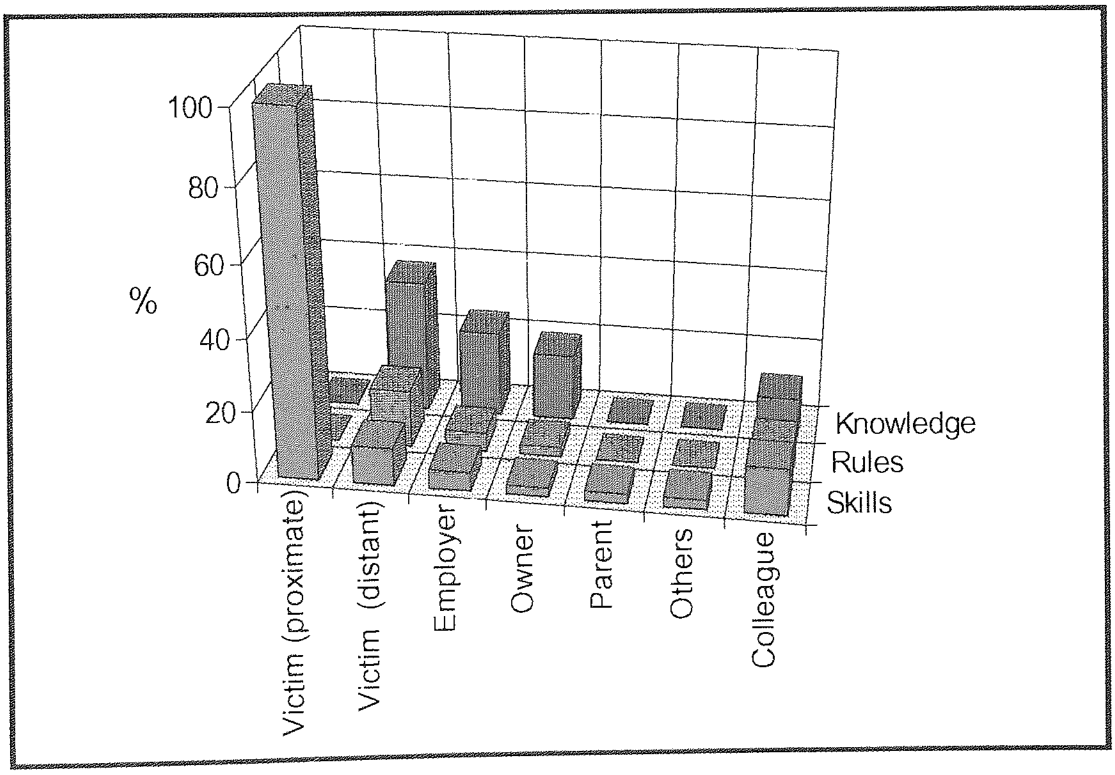


Figure J.2 Matrix cell E1 - Percentages of skill, rule, and knowledge based errors

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	0	15	10	7	0	0	4
Control	38	10	4	2	1	1	8
	38	25	14	9	1	1	12

Table J.10 Matrix cell E1 - Identification/Assessment vs Control failures (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Identification/ Assessment	0.0	39.5	26.3	18.4	0.0	0.0	10.5
Control	100.0	26.3	10.5	5.3	2.6	2.6	21.1
	100.0	65.8	36.8	23.7	2.6	2.6	31.6

Table J.11 Matrix cell E1 - Identification/Assessment vs Control failures (percentage)

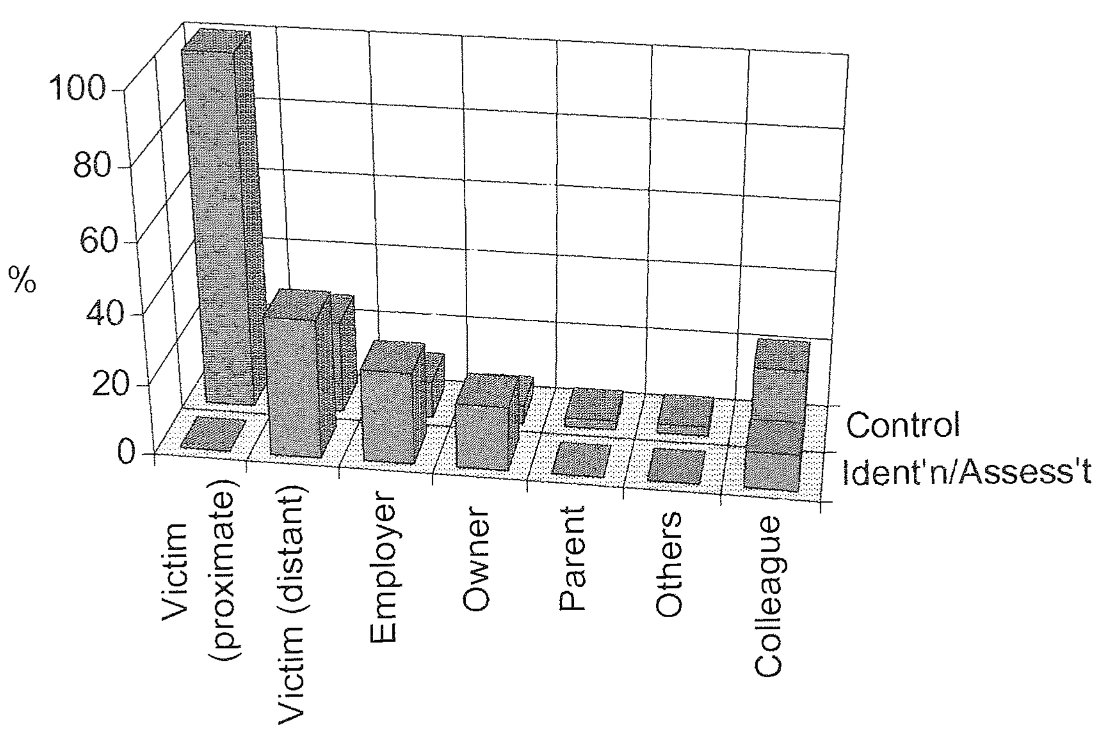


Figure J.3 Matrix cell E1 - Identification/Assessment vs Control failures

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	38	4	2	1	1	1	5
R - Errors	0	2	0	1	0	0	1
K - Errors	0	1	5	2	0	0	0
Violations	0	18	7	5	0	0	6
	38	25	14	9	1	1	12

Table J.12 Matrix cell E1 - Skill, rule, and knowledge based errors vs Violations (number)

	Victim (proximate)	Victim (distant)	Employer	Mach'y owner or land occupier	Parent	Other e.g. Manufacturer supplier, utility	Colleague
Skills	100.0	10.5	5.3	2.6	2.6	2.6	13.2
R - Errors	0.0	5.3	0.0	2.6	0.0	0.0	2.6
K - Errors	0.0	2.6	13.2	5.3	0.0	0.0	0.0
Violations	0.0	47.4	18.4	13.2	0.0	0.0	15.8
	100.0	65.8	36.8	23.7	2.6	2.6	31.6

Table J.13 Matrix cell E1 - Skill, rule, and knowledge based errors vs Violations (percentage)

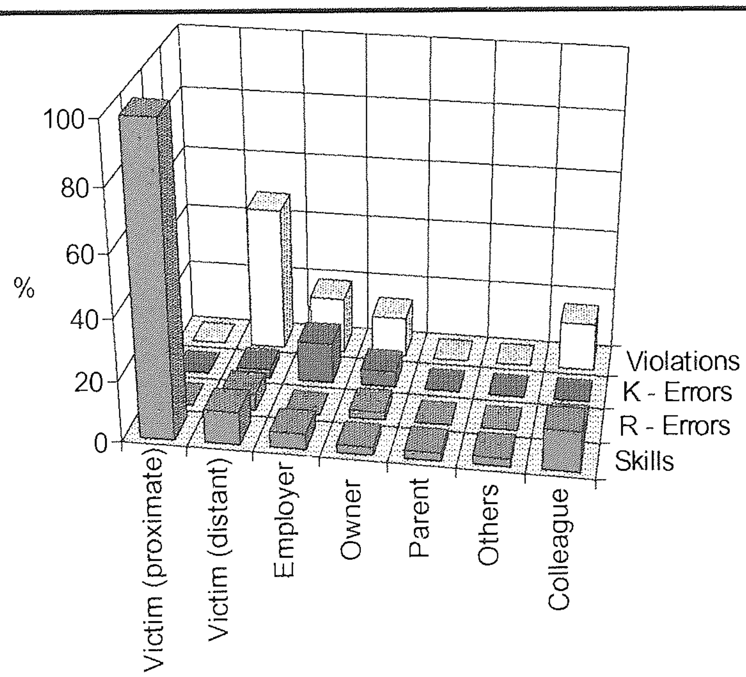


Figure J.4 Matrix cell E1 - Skill, rule, and knowledge based errors vs Violations

Chapter 6. Reliability

6.0 Introduction

In the early stages of the research the coding of a sample of accidents was discussed and confirmed with supervisors. Initial reliability of coding between researcher and supervisors was found to be good. Coding of most of the accident reports was done by one person, and no formal checks on the reliability or objectivity of the researcher's coding were undertaken during the course of the accident coding. This was discussed briefly in Chapter 4 section 4.5. Following complete coding a seminar was held to assess the reliability and objectivity with which the accidents had been coded against the matrix.

6.1 Seminar objectives

The objectives of the seminar were

1. to assess the reliability and objectivity of the coding of the accidents considered against the Hale-Glendon model,
2. to discuss and reconcile any differences and,
3. to draw conclusions as appropriate.

6.2 Format of the seminar

The membership of the panel of experts who were to take part in the seminar was designed to capture a broad range of experienced accident investigators and analysers, drawn from HSE and from the Health and Safety Unit at Aston University.

The panel was chaired by Professor R T Booth and members included: a Principal Agricultural Inspector with over thirty years experience in the investigation of agricultural accidents; an experienced Inspector with a particular interest in accident analysis who had carried out project work to assess the viability of HSE making greater use of accident causation models during investigations; a second experienced Inspector who had recently been involved in the compilation and analysis of the annual summaries of fatal injuries produced by HM Agricultural Inspectorate; Dr A I Glendon co-originator of the model being used; three research students, one with expertise in accident investigation methodologies, one carrying out research into the use of BS 8800, the new British Standard for Occupational Health and Safety Management Systems, the other researching accident recording systems in use within the European Union.

To obtain a manageable number of accident reports for consideration by the expert panel at the seminar, twenty-five numbers were selected randomly using a spreadsheets random number generator. This total was reduced to 17 because of duplicate numbers and because some of the randomly generated numbers were found not to have been used for accident records. Subsequently it was realised that none of the randomly generated numbers related to a child accident. Two child fatalities were therefore randomly selected. This was done by viewing at random a page from the computer file of Appendix 1 to this thesis, and the child accident nearest to the randomly selected page was used.

For the seminar participants to have examined all of the original documents would have been too time consuming. It was therefore decided to prepare a one page résumé of each of the selected accident records. The résumés would be used by the seminar participants, but the full original documents would be available at the seminar and could be consulted if needed to resolve differences, or to clarify a point. Each résumé contained the case summary (as shown in Appendix 2 of this Thesis) together with further information about the accident. There was also sufficient space left for each seminar participant to record their initial thoughts on what the coding should be and to comment on the actual codings and discussions. An example of one of the case résumés is included at Figure 6.1. Clearly each résumé contained only a small fraction of the material available to the researcher when the original coding was done.

After introductions, the objectives and format of the seminar were explained to participants. The Hale-Glendon model and the accident causation matrix were also explained. Participants were then issued with brief instructions for coding the accidents. The instructions required the participants to first read through the documentation to get an overview of the scenario. The categories of persons involved at the scene of the accident were then identified. e.g. deceased, fellow workers, parent etc. Participants were also invited to consider the involvement of categories of party who were not physically present at the accident scene but who may have had an influence. e.g. employer who set the victim to work doing that job at that time, in that way. Finally participants were instructed to identify progressively those categories of party involved further back in time e.g. employer, designer etc.

Having identified all of the parties involved in the accident antecedents, participants were invited to consider each party in turn, and to describe each fault in general terms. e.g. deceased didn't run fast enough to escape from the bull/fire/falling object, designer failed to foresee the way in which machine would be used. The faults were considered in order, proximate by deceased, distant by deceased, proximate by others, distant by others.

The seminar participants then compared each identified fault sequentially against the model. Starting at matrix cell A1 and answering the implied questions, participants went from cell to cell until the answer to the question in the cell was No, or they could not be sure that it was Yes. Participants took account of the evidence presented in the fatal accident reports, and the level of knowledge, skill and understanding that that party should have had at that time.

Case No 21

The 16 year old son of a farmer entered the lower hatch of a moist grain silo in an attempt to rescue his father's employee who had been overcome after entering the silo through the top hatch. The silo had been ventilated by leaving the top hatch only, open for several hours. The danger of gas was known but it was not appreciated that the gas was heavy.

Further information

- February 1979, Pembrokeshire
- Boythorpe Cropstore Moist Grain Silo, 86 tonne, 27 ft high
- normally strong healthy 16 year old boy, asphyxiated
- silo 1/4 full, problems with barley lodging on sides
- initially barley cleared using a rope with a weight on it swung into the side
- farmer/father discussed with worker, and decided that someone should enter to shovel barley to auger
- discussed need to open top hatch for 2 hours, done
- later decided that safe to enter since hatch had been open during morning
- farmer had assumed safe since couldn't smell gas and hatch had been open
- worker then lowered into silo to remove slats and open bottom hatch
- worker in difficulties so bottom hatch removed, barley cascaded out
- deceased volunteered to enter but farmer/father could smell gas so dissuaded until had rope, went to get rope
- on return found son had entered anyway and been overcome
- farmer thought that instruction to 'test for gas before entering' meant that if couldn't smell gas then it was safe
- worker had been able to smell gas in morning but not in afternoon when entered
- deceased trying to save worker a lifelong friend

Initial coding

Comments on Researchers coding

Any other Comments

Figure 6.1 Coding sheet used at seminar

For example, an experienced farmer or worker should know that pto's must be guarded, and that children must not be carried on tractors, whereas an inexperienced operator may not be expected to know how to fell a tree correctly, nor would a child be expected to be as aware of a particular hazard as an adult.

One of the cases, Number 100 was discussed and explained in detail to demonstrate the coding technique. Participants were issued with a bound version of the 19 cases, together with a copy of the matrix and the coding instructions.

6.3 Methodology

Having explained the methodology to the participants, they were invited to consider the first case. The participants read the details of the accident, then identified the parties, and their failure mode or modes. The point on the matrix corresponding to these failures was identified and coded. The researcher's codings was then revealed and participants were invited to discuss why they had coded the accident as they did, and differences identified and explained. Two further cases were considered in this way.

Certain common threads appeared in the discussion early on so it was decided that subsequent cases should be considered in a slightly different way. The final two cases were considered in three pairs, one a researcher from Aston, and the other an agricultural specialist. Each pair had an observer who reported back to the group on the discussion.

6.4 Results

Results for individual cases are described below.

The first case considered (No 100) was selected as the example to give to explain the coding methodology since it was felt that the facts were fairly straightforward and there should be very little argument. In the event there was some discussion on what was the most appropriate coding.

The facts were that whilst driving a tractor on a sloping track the deceased, a 72 year old male, dismounted to open a gate. Having failed to fully apply the handbrake the tractor ran forward over him. The further information provided for seminar participants was:

- 1400, October 1979, Powys
- 72 year old farmer in good health
- died of chest injuries when tractor ran him over
- farm track had 1 in 10 slope
- gate out of field appeared to have been forced open against its normal direction of opening
- handbrake five clicks from full application
- tests revealed that this was not sufficient to hold tractor on slope
- full application of handbrake would have been effective in holding tractor on the slope
- presumed that he dismounted from the tractor to open the gate
- the unmanned tractor ran forward over him

The accident had been coded as E3 for the deceased. He was functioning at the rules-based level, and clearly knew the correct procedure (i.e. to apply the handbrake), but failed to execute the task correctly. It was felt that if the deceased had seen or heard the tractor rolling towards him, then a further coding of E1 would be valid since he would have become aware of an insistent danger signal, but failed to have successfully executed the correct response. There was also further discussion on the role of the designer in that a backup to the handbrake had not been provided, but this was felt to be impractical.

Details of the second case considered (No 21) are shown in Figure 61. Here the seminar participants identified the parties involved as the 16 year old deceased, his father (employer and owner of the tower silo) and the worker. A summary of the results from each of the seminar participants is shown in Table 6.1.

Seminar Participants	1	2	3	4	5	6	Original Coding
Case parties							
Deceased	D2	D2	C4	D2	C4	D2	D2
Employer	D2	B6	-	B6 and D2	-	D2	D2
Worker	D2	-	C4 or D2	-	-	D2	D2

Table 6.1 Participants codings for parties in Case 21

There was a fair measure of agreement that all three parties could be coded D2 (correct procedure (not) known). Two participants initially felt that the deceased's actions should be coded C4 because of doubts over whether he had perceived an 'obvious warning'. After clarification a coding of D2 was agreed. Two others suggested a coding of B6 (correct test (not) chosen, or (not) correctly executed) for the employer 'in the initial stages of the accident sequence'.

There was also some discussion of the role of the designer in this accident. Tower silos routinely have a warning message cast into the metal of the bottom hatch. In this case those involved correctly identified that there was likely to be a problem with gas but the farmer seems to have assumed that the situation was safe since he couldn't smell the gas and the top hatch had been open for a couple of hours.

The third case considered was number 32. The facts were that a 70 year old part-time worker was using a nine rung wooden ladder to gain access to a compost hopper on a machine at a mushroom farm. The ladder slipped and the deceased fell receiving a hairline fracture of his pelvis. He died six days later from a pulmonary embolism. The further information provided for seminar participants was:

- February 1979, Lancashire
- retired mushroom worker returned part time for $13^1/_2$ a week
- cleaning machine known as a Tamplin line
- deceased had done work before, would need to use a ladder to gain access to hopper about 6 ft above ground
- machine fills boxes with compost, sows spores, then compresses the compost
- machine in clean well lit concrete floored building
- using hand tools and water, plus 9 rung 11 ft ladder (missing top or second rung, but tie rod present)
- location of missing rung meant that this would not have contributed to accident
- no eyewitnesses
- deceased fell from ladder or ladder fell with him on it
- deceased in good health before accident,
- after fall had four days in hospital, returned home collapsed four days later
- pathologist said hairline fracture of pelvis led to blood clots in lower legs and accumulation in lungs
- employer told by deceased that ladder had slipped from under him
- generally very high standards on this holding

A summary of the results from each of the seminar participants working alone is shown in Table 6.2.

In this case there was little agreement about what the coding should be. All six participants produced a code for the deceased, four for his employer, and two coded for the designer of the machine.

Seminar Participants	1	2	3	4	5	6	Original Coding
Case parties							
Deceased	D2	E1	E1	C4	C4	E1 D2 E7	B6
Employer	D7	-	C4	C4	C4	-	C7
Designer	-	-	-	D3	C6 D3	-	C6

Table 6.2 Participants codings for parties in Case 32

The seminar participants felt that there was insufficient human factors information available in the inspector's report to make a realistic coding attempt, particularly information about the employer's knowledge and actions. Depending upon the assumptions made, credible codings could have been produced at the skills-, rules- or knowledge-based levels of functioning. In this case use of the model highlighted the need for the investigating Inspector to make appropriate behavioural-based enquiries at the time of the investigation and to record the results. Ironically in this case the injured person remained alive, and available for interview for up to eight days after the accident.

The fourth case to be considered was number 88. This concerned a 61 year old general farm worker who was operating a slurry tanker with an unguarded power take-off shaft. He became caught by his clothing. The further information supplied to seminar participants was:

- May 1979, Somerset
- MF 188 and Fulvac slurry tanker
- verdict misadventure
- deceased employed five years, regular job to empty slurry pit, daily
- guards available for tanker pto shaft but not fitted

- fellow employee confirmed that workers required to use tanker had received instruction in its safe use
- wet/windy day
- employer confirmed that deceased had been instructed in safe use of tanker and was its principal operator
- employer denied knowing that pto guard missing
- system was to make each tractor driver responsible for own equipment
- drivers had been instructed to either report missing or broken guards or to obtain replacement
- tractor deficiencies included no marking of control valves, and no pto shield
- tanker deficiencies were no drawbar shoe and no pto shaft guard
- Prohibition Notice issued and prosecution proposed

A summary of the results from each of the seminar participants working alone is shown in Table 6.3.

Seminar Participants	1	2	3	4	5	6	Original Coding
Case parties							
Deceased	C4	-	D3	C3	C3	C3	C3
Employer	C5	-	E7	E3	E3	E3 and D3	E3

Table 6.3 Participants codings for parties in Case 88

There was reasonable agreement about the coding of this case. The only parties felt to be involved were the deceased worker and his employer. After discussion all the seminar participants agreed that the deceased should be coded at C3 (responsibility for implementing procedure (not) accepted), and his employer at E3 (procedure (not) correctly executed) although it was felt that a coding of D3 (correct procedure (not) chosen) would also be appropriate for the employer's failure to ensure that the guard was fitted, if there was no procedure to cover the replacement of defective guards. In this case there was a procedure which failed to work properly because its working was not monitored. Further information from the Inspector and an Events and Causal factors analysis prior to coding would probably have clarified this.

The final two cases were considered in pairs. Each pair comprised a researcher and an Inspector. An observer reported back to the whole group.

The first case considered in pairs was number 99. This concerned the use of a McConnell digger attached to a Massey Ferguson 35 tractor to push boughs into a hedge bottom. The deceased, a 30 year old tractorman became trapped between the control console of the digger and the rear cross-member of the safety cab. The further information supplied to seminar participants was:

- 1430, 1979, Isle of Arran
- MF 35 tractor with Lambourne Mk 5 safety cab.
- McConnell Power Arm S12 digger being used to push boughs into hedge bottom
- employer and other worker (student) working at some distance
- other worker was student in 3rd week with no knowledge of machine
- sound of tractor became continuous rather than fluctuating
- ran to machine and released deceased by driving tractor forwards
- typical McConnell accident, deceased tried to move tractor by pushing with the bucket
- trapped when tractor wheels wouldn't go forward probably because of mound of earth in front of one wheel
- deceased had operated outfit for 13 years
- may have been unaware of danger
- original instruction booklet advocated this system of work
- employer unaware of problem

- McConnells had no record of this owner
- employer left operation of machine to the deceased worker

A summary of the results from each of the seminar participants working in pairs is shown in Table 6.4.

Seminar Participants	1	2	3	Original Coding
Case parties				
Deceased	C4	C4	C4	C4
Employer	C4	C4	C4	C4
Student	C4	-	-	-
Manufacturer	-	-	-	E7
HSE	-	-	-	E7

Table 6.4 Participants codings for parties in Case 99

The three inspector/researcher pairing agreed that the problem was one of failure to identify that there was a danger, and coded the accident C4 for both the deceased and his employer. One pair also felt that there could have been a coding of E1 for the employer after the accident to account for his lack of skill which led to the delay in releasing the trapped worker. However it is unlikely that this would have affected the outcome because of the earlier and greater delay in identifying that there was a problem and in reaching the trapped worker. One pairing also coded the student as C4. However the student was in only his third week at work and had no knowledge of the machinery involved. None of the pairings considered the involvement of the designer of the machine nor of HSE's involvement once the problem had been identified.

A number of issues was discussed whilst deciding upon the appropriate coding. The level of knowledge possessed by the deceased was unclear. The deceased was the expert in the operation of that machine and had been its sole operator whilst on the farm. Neither HSE nor the machine manufacturers had contacted the owner to bring the known problem with these machines to his attention, and there was no evidence to suggest that the deceased had any idea about the danger presented by the combination when such diggers are mounted on a tractor fitted with a cab, frame or rollbar. The time frame of the accident was also discussed. In this case it was felt that the total time between the employer becoming aware that the tractors engine note had ceased to fluctuate, deciding to investigate, and then realising whilst walking towards the machine that there was something wrong, was too great for him to have been able to save the employee.

The second case considered by the pairs was number 124. In this incident the deceased was working as one of a two-man gang cutting up trees which his colleague had felled. The colleague felled a 100 ft spruce tree not realising that the deceased was only 85 ft away. The deceased was wearing a safety helmet but died from multiple injuries to the body. The further information supplied to seminar participants was:

- 1140, February 1980, in Lincolnshire
- 47 year old, worked as a forestry worker with colleague for the previous nineteen years
- 100 ft dead spruce correctly felled uphill as instructed
- deceased wearing helmet with ear defenders (not used) attached
- feller looked and shouted a warning before felling tree
- had felled thousands of trees together and had good working understanding
- team adequately trained, supervised and experienced
- deceased obscured by a rise in the ground
- deceased knew felling about to commence but was within 2 tree lengths, and not where he should have been

A summary of the results from each of the pairs of seminar participants is shown in Table 6.5.

Seminar Participants	1	2	3	Original Coding
Case parties				
Deceased	D3/E3	D3	C4/B6	C4
Colleague	-	E3	D2	E7
Management	-	-	D2/D3	C6

Table 6.5 Participants codings for parties in Case 124

In this case the codings arrived at by the parings were very diverse. The first pairing decided that the failure of the deceased fell in the grey area between D3/E3 (failure to select the correct procedure, or having selected it, failure to correctly execute it). The second pairing felt that the question of whether the deceased had received an 'obvious warning' was crucial but was very difficult to pin down on the evidence. Both the first and second pairings concluded that the deceased had received an obvious warning. The third pairing decided that although the feller (colleague) shouted a warning of impending danger this would probably not have been obvious to the deceased because of the noise from his own chainsaw. They concluded that the deceased's failure occurred at the boundary between C4 (need to test for danger (not) known, or (not) recognised), and B6 (correct test (not) chosen, or (not) correctly executed).

In the case of the feller the second group concluding that there was an obvious warning but that he had failed to correctly execute the procedure. The third group after much discussion, concluded that there was an obvious warning and coded the error by the feller as E3 (procedure (not) correctly executed).

The third pairing coded the error by the feller as on the boundary between D2 (correct procedure (not) known) and D3 (correct procedure (not) chosen), depending on whether he knew what was a safe system. In this case the differences in coding were attributable almost entirely to differences in the assumptions made by the seminar participants (see below).

6.5 Discussion

Several important issues were highlighted at the seminar. A number of coding variations both among seminar participants and between them and the researcher were attributable to shared and different assumptions. Industry knowledge led to some assumptions, whilst lack of knowledge led to different assumptions, or more importantly to no assumptions. Whilst extra information was available in the full reports this was generally insufficient to arrive with certainty at a particular coding. This was partly due to the information collection and recording system used by Inspectors not having been designed to record the information necessary for this research, and partly to the nature of the accidents studied.

This research has been concerned solely with fatalities in the agricultural industry, an industry where working alone is increasingly becoming the norm. This has meant that often there has been no eyewitness, and except in cases where death is delayed, no victim available to interview. With hindsight it would have been better to have carried out this research on non-fatal accidents which occurred in a labour intensive industry, so that both the victim and eyewitnesses could be interviewed. It would also have been better to have gathered the information firsthand rather than by relying on the Inspector's reports.

There was some discussion at the seminar about terminology, particularly the use of the words 'obvious warning' in the Hale-Glendon model and at cell B2 on the matrix. What is an obvious warning to one person may not be obvious to another, and just because the 'obvious warning' exists it cannot be concluded that it has been detected or correctly interpreted. When coding accidents on the matrix the decision on whether or not an obvious warning exists and is perceived as such is critical to the eventual coding. The D3 and E3 codings (correct procedure (not) chosen or (not) correctly executed) are very similar to the D7 and E7 codings (correct plan/procedure (not) chosen or (not) correctly executed), but the recommendations for prevention would be very different.

At present the method of coding is to follow from one cell to the next, answering the implied questions, until the answer is a definite no, or there is insufficient evidence for a yes. The process could be criticised as making arguable judgements on questionable data. It was suggested that it may be better to split the matrix into three separate areas so that the model is approached from above rather than following the arrows sequentially. In this approach the matrix would be split into three areas, representing the skills-, rules- or knowledge-based levels of functioning. Having read the accident report an initial coding into the relevant part of the matrix would be decided upon. A drawback of this approach is that the skills-, rules- and knowledge levels of functioning are a continuum and do not form discrete categories.

The seminar again drew attention to the problem of the absence of a time frame. Often there was little certainty between the seminar participants about what time the error being considered occurred. Case number 100 concerned the 72 year old tractor driver who was crushed against a gate when he failed to fully apply the tractor handbrake. The accident was coded as E3 (procedure (not) correctly executed) for the deceased who was the only person involved. This coding reflected the fact that the deceased had applied the handbrake (indicating that he had chosen the correct procedure) but that it he had not fully applied it (i.e. his execution of the task had been defective). This distant/latent error occurred shortly, perhaps a minute before the accident. Having dismounted walked towards the gate and partially opened it, the deceased was struck by the tractor which had rolled forward. Discussion at the seminar centred on whether the deceased might have heard the tractor coming, but failed to escape. If this had happened there would have been an E1 (response (not) correctly executed) type error. Even if the deceased had heard the tractor he may not have interpreted what he was hearing as an insistent danger signal, but may simply have turned to look for confirmation of the source of the noise. There was no evidence in the report about: the state of the deceased's hearing, which because of his age could be expected to be less than perfect; the weather conditions which may have had a bearing on what he might hear; which way he was facing when found which may have confirmed whether or not he had heard the tractor coming; nor was there any evidence about how agile he was.

One way of overcoming the timeframe problem discussed above would be to carry out an Events and Causal Factors analysis to identify in a structured way, the parties involved and the points at which their faults occurred. Each fault could then be coded on the accident matrix.

6.6 Events and Causal Factors Analysis

Events and Causal Factors Analysis (Kingston-Howlett, 1995) is a technique of accident analysis designed to be used alone, or in conjunction with other methods in the Management Oversight and Risk Tree (MORT) programme. The technique provides a structure within which investigation findings can be organised, and causal chains and event sequences verified in a way which is easily understood and explained.

Following the seminar, a number of ECF analyses were carried out in order to identify the time frame of the accident antecedents and to confirm that all parties errors had been identified. The three examples included at the end of this Chapter, have been selected because they are some of the more complex ones, involving several parties, and also because of the relatively good quality information available.

The first case (No 69) involved a 10 year old girl visiting a 'Pick Your Own' farm as a member of a church youth group. She was being carried on a low loader trailer from one part of the farm to another. A purpose designed and built trailer with sides to prevent anyone from falling off would normally have been used but was unavailable that day. The trailer actually used had no sides, and bales were used for seats. The girl appears to have followed the supervisor who jumped from the trailer. On landing she fell back under the trailer wheel. The ECF chart for this accident is at Figure 6.2.

In this case the owner of the equipment knew there was a risk of injury should a passenger fall or jump from a trailer. Moreover he was aware that under the Agriculture (Avoidance of Accidents to Children) Regulations 1958, it was an offence for any person to permit a child to ride on such a trailer when there were no sides fitted. Having set up a procedure to ensure that a safe trailer was used, he then failed to ensure that it was correctly implemented when the purpose built trailer became unavailable.

On arrival at the farm one supervisor went to the weighing point leaving all of the children in the care of the second supervisor, who accompanied them on the trailer for a short time before jumping off to go and pick peas. Even before jumping from the trailer it appears that the supervisor did not have adequate control of the children. The girl appears to have followed the supervisor's lead in jumping from the moving trailer but slipped on landing and failed to avoid the trailer wheel. Meanwhile the driver being aware that the children were a bit unruly, had chosen the correct procedure of stopping the tractor and warning the children twice. However he then failed to keep an adequate lookout and didn't see the child jump and fall beneath the wheel.

The second example of an ECF analysis (No 105), involved a 77 year old fit, active farm foreman who was knocked down by a reversing trailer loaded with sugar beet. The tractor driver had seen the foreman approximately 100 yards from a sugar beet pad before setting off to drive the 200 yards to it. Unknown to him the foreman had walked to the pad and arrived before the tractor and trailer. The foreman was picking leaves from among the beet when he was struck by the reversing trailer and sustained a broken leg. It is likely that immediately before the trailer hit him he saw or heard it coming, but still failed to effect his escape. Whether or not his hearing was impaired appears not to have been enquired into, nor did the Inspector report on whether or not the tractor driver had reversed at speed towards the stack in order to tip the beet as high up the pile as possible.

The employer and owner of the machine was aware that rearward visibility with the tractor trailer combination was bad, but failed to recognise that as a potential source of danger. The tractor driver maintained that he checked his rear-view mirror before reversing but failed to see the foreman, whom he was not expecting to be where he was. The deceased died six days later of a pulmonary embolism, following thrombosis caused by his broken leg. The ECF chart for this accident is at Figure 6.3.

The final example of an ECF analysis (No 179) involved a 23 year old experienced mechanic turned crawler tractor driver who was returning to the farmstead driving a loader shovel. In order to avoid a sharp turn onto a bridge, he chose a straight route down a moderate hill. The transmission overrode the engine which stalled. The loader shovel ran down the hill out of control, hit the side of the bridge, slid then toppled into the stream, trapping the deceased beneath one track which had become detached during the overturn. The ECF chart for this accident is at Figure 6.4.

In this case the deceased had been employed for about 3½ years as a fitter in the farm workshop, work in which he was both skilled and experienced. However he was relatively inexperienced in driving the crawler tractor, the task in which he was engaged at the time of the accident. In particular he chose a steeper but straighter downhill route towards a bridge which he had to cross to return to the farm. As the tractor gathered speed the driver failed to prevent the transmission from overriding the engine causing it to stall and the tractor to run away out of control. The driver stayed in the cab and appears to have tried to steer the tractor over the bridge. He was almost successful, but the tractor caught the side of the bridge and overturned into the water.

In this case the employer did not appreciate that although the employee had been working with him for some time, he had received no training nor was he experienced in driving the crawler tractor. The employee chose the straight route down a 1 in 10 hill, apparently to avoid a sharp turn onto the bridge which the alternative route would have involved. Not having driven downhill before and not having seen the instruction book he was not aware of the correct procedure for driving this type of tractor downhill.

Whilst carrying out the Events and Causal Factors Analysis of this accident it was realised that there was a second previously unidentified error by the deceased. This occurred once the tractor started running away downhill and involved the driver not responding correctly to prevent the engine overriding the transmission. In view of the deceased's lack of instruction, training and experience this failure was coded as A1 (insistent danger signal, but correct response not in programme).

6.7 Conclusions

The methodological issues highlighted during the seminar discussion were as follows:

(a) all of the coding was done by one person, who had detailed knowledge of both health and safety and of the agricultural industry;

(b) there were a number of shortcomings in the original reports which were prepared by Inspectors rather than by researchers. This meant that the analyst had to make assumptions based upon his experience;

(c) variations were discovered in the location of errors in time which led to inconsistencies in the coding, and a lack of transparency;

(d) the use of ECF analysis for all of the accidents, would if adopted have assisted in the identification of all errors, and clarified their locations in time;

(e) there were some shortcomings identified both in the translation of the Hale Glendon model into the matrix, and the subsequent use of the matrix to code the accidents;

(f) in many cases it was not possible to distinguish with certainty between 'insistent danger signals' and 'obvious warning';

(g) violations were not separated out and given their own distinct coding locations;

(h) it was erroneously assumed that violations only occurred at the knowledge level, some could be at the rule and skill level. An example of this might be the well learnt violation of putting ones foot on the accelerator when approaching traffic lights which are about to turn red;

(i) some coding locations still embrace two steps which may be distinguishable;

(j) the limitations of the data, particularly the non availability for interview, of the victim, meant that some errors were coded to a particular cell simply because there was a lack of evidence to justify proceeding further;

(k) the cases considered at the seminar were described to the participants by means of brief accident résumés. This tended to highlight (usefully) some of the coding and structural issues described above.

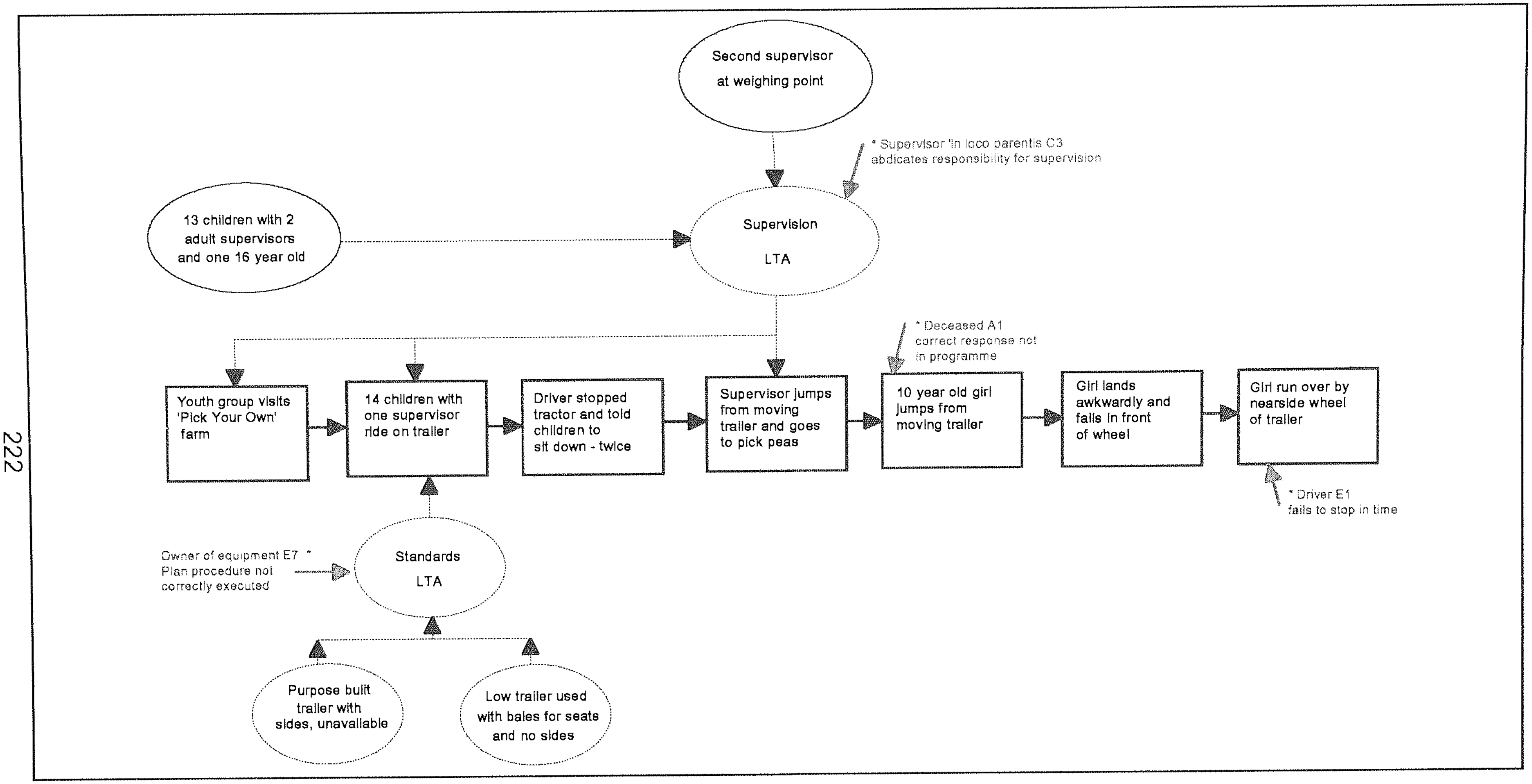


Figure 6.2 Events and Causal Factors Analysis of Case 69

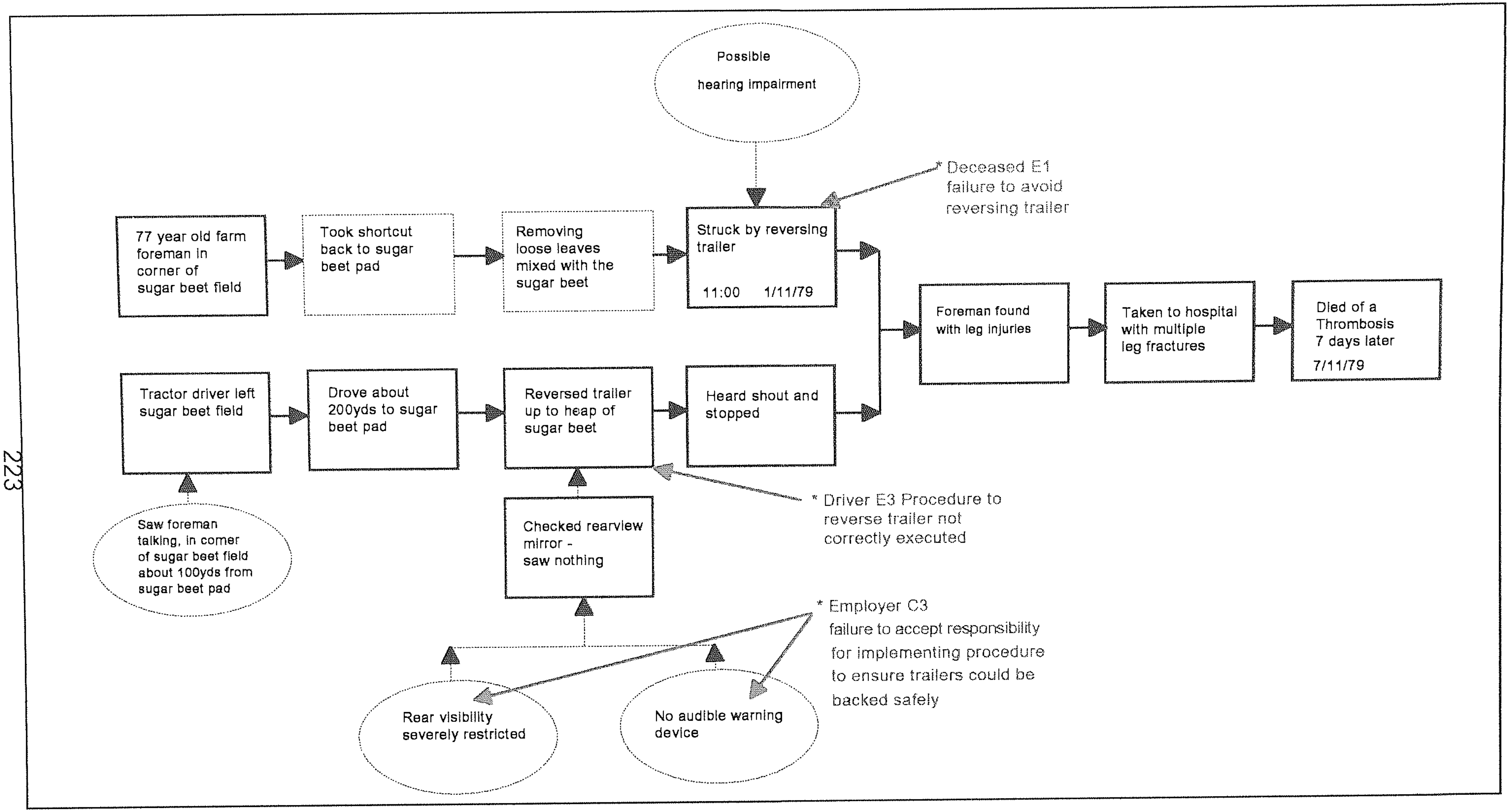


Figure 6.3 Events and Causal Factors Analysis of Case 105

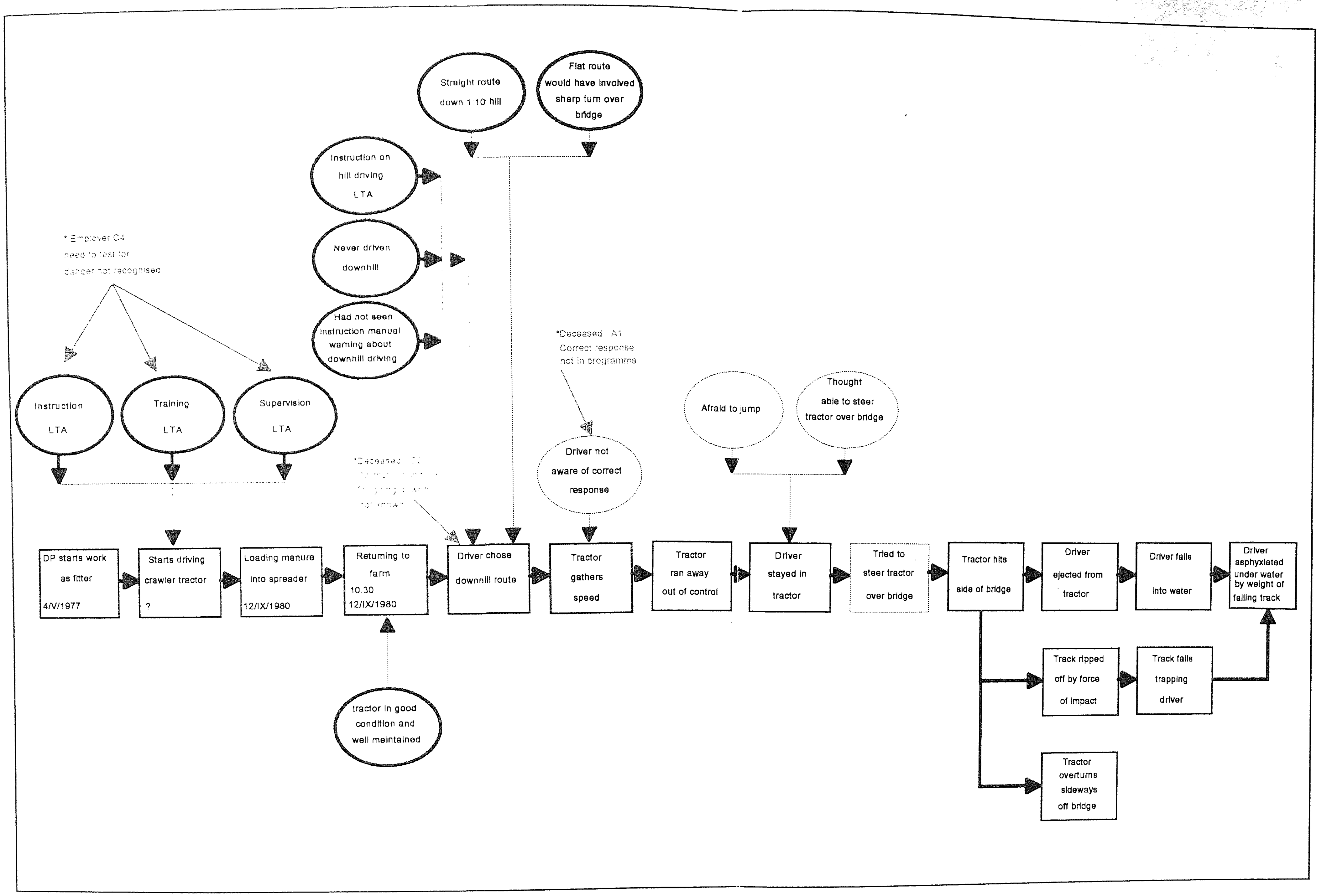


Figure 6.4 Events and Causal Factors Analysis of Case 179

Chapter 7. Discussion

7.0 Introduction

The Agricultural Industry in Great Britain has seen massive changes over the past four decades. Hardly any area of farmwork has remained untouched by the march of mechanisation. New plant breeding techniques, have led to massive yield increases in many staple crops. The realisation of these higher yields has been made possible by the development of new chemicals to protect crops during their growth and storage.

One effect of these changes is that whilst total production has been maintained in some crops, it has increased in many others. The trend towards producing more from less land is likely to continue particularly if genetically engineered crops become widely available. This country is at last in the fortunate position of having to grapple with the problems of overproduction rather than of struggling to feed its population.

These changes have also had a major effect upon the size and makeup of the population at risk of being injured in agricultural accidents. The size of the employed labour force has declined to less than a half of what it was; the average size of working farms has increased, with a consequential decrease in the number of such farms; the work formerly carried out by regular full-time employees is increasingly carried out by family members, with part-time and casual workers and specialist contractors employed to cover busy periods; farmers seeking extra income have diversified into new and novel enterprises; and the general population of this country have increasingly come to view the countryside as a national resource to be used for recreational purposes.

The Agriculture (Safety, Health and Welfare Provisions) Act came into force on 5th July 1956. Over the next 18 years a number of specific Regulations were made under it. They were designed to address the health and safety issues of the time; ladders; power take-offs; children; circular saws; workplaces; stationary machinery; threshers and balers; field machinery; and tractor cabs (Ministry of Agriculture Fisheries and Food 1956, 1957, 1957a, 1958, 1959, 1959a, 1959b, 1960, 1962, and 1974). The Regulations with one exception, applied to the situation in which an employee was employed to work on a farm, and were designed to protect that employee from harm. The exception was the Agriculture (Avoidance of Accidents to Children) Regulation 1958 (Ministry of Agriculture Fisheries and Food, 1958) which regulated the presence of children on agricultural machinery.

During the period since the 1956 Act and Regulations came into force there has been a decline in the absolute numbers of fatalities in the industry. Earlier figures are not available but in 1966 there were 135 people killed on farms in Great Britain (Butterworth 1976). This figure has declined to an average of less than 50 per year so far in the 1990s (Health and Safety Executive (1996).

Some of the decline in the number of fatalities is undoubtedly due to the success of specific regulations. Butterworth showed that in 1966, 53 people were killed in tractor overturning accidents, which was almost 40% of all of the agricultural fatalities in that year. More recent figures (Health and Safety Executive, 1993a) show that during 1992/93 6 people were killed by overturning tractors, which was 12.5% of the total fatalities. In 4 of the 6 cases the tractor which overturned was not fitted with a safety cab or frame. In one case the frame was folded down and inoperative, and in the other the deceased was ejected from within the safety frame during a multiple overturn. None of those killed were farm employees, to whom the Agriculture (Tractor Cabs) Regulations 1974 applied (Ministry of Agriculture Fisheries and Food 1974). The number of deaths from overturning tractors has continued to decline and in the most recent year for which figures are available 1995/96 (Health and Safety Executive (1996), there were no fatalities attributed to this cause. This is believed to be the first year, since tractors were introduced, that this has happened. In 1995/96 there were three deaths during vehicle overturns, however none involved a tractor within the meaning of the regulations.

Legislation relating to the guarding of power take-off shafts has had a much less dramatic effect, at least in terms of preventing fatalities. Recent figures (Health and Safety Executive, 1993a, and 1996) confirm that nobody was killed in power take-off accidents in 1991/92 or in 1992/93, and that for the ten year period 1986/87 to 1994/95 there were only 6 deaths from this cause. Butterworth (1976) showed that between 1966 and 1974, 14 people were killed by power take-off shafts. Thus the average number of power take-off fatalities has fallen from about 1.6 per year in the five years either side of 1970, to about 0.6 in the five years either side of 1990.

Whilst the fall in numbers killed on farms has been dramatic, much of it may be accounted for by the decline in the population at risk, especially to the fall in the numbers of employees to whom the detailed Regulations apply. However whilst it is currently unclear whether or not the fatal injury incidence rate for self-employed people is rising, it is certainly not falling as is the rate for those to whom the Regulations apply. Moreover the greater use of land for recreational purposes means that there is an increase in visitors to the country, and hence in the population at risk. Additionally that population is composed of persons in higher risk categories, such as agriculturally naïve 'townies' and children.

A small part of the decline in the numbers recorded in official statistics of agricultural fatalities can be accounted for by minor variations in what has and has not been included in the statistics over time. When examining fatal accident records for the late 1970s it was noted that there were a small number of diseases and road traffic accidents included in the statistics which would probably not have been included if the accident had happened more recently. Examples include an instance where the deceased was riding in a link box mounted on a tractor's three point linkage, when the tractor was involved in a Road Traffic Accident (RTA). Deaths due to diseases not attributable to a particular incident, such as Farmer's Lung were until recently counted with the accidents, and even an occasional death arising from being struck by lightning was included. More recently such incidents have been excluded from the statistics. Deaths due to Farmer's lung were excluded from the sample used in this research. There were no deaths due to lightening in the three years studied.

Currently there appears to be little scope for initiatives which are likely to further significantly reduce the number of deaths on farms, either by introducing prescriptive legislation designed to address a particular problem, or by more rigid enforcement of the existing regulations. There appear to be no simple hardware orientated solutions left.

No attempt has been made in this research to examine systematically some of the more radical hardware, or software solutions which might prevent accidents. For example:

- would it be reasonable to expect all overhead cables to be fully insulated?;

- should manufacturers be producing tractors fitted with stability sensors which would sense the terrain and surface grip, then halt the tractor safely without it turning over, if the parameters exceed a safety 'envelope'?;

- should tractor engines be interlocked so that they stop when the driver leaves his seat?;

- should tractor engines be interlocked to the tractor's power take-off?;

- should certain categories of person (the young or old) be prohibited from carrying out certain tasks, e.g. tractor driving, tree surgery etc.?;

- should the wearing of seat belt on tractors (at least on the road) be made compulsory?;

- should the wearing of head protection during tree work be made mandatory?

To begin to make further inroads into the toll of fatal accidents on farms we need to look more closely into the minds of the people who have been involved in any way in accidents; to discover why they did what they did which caused the accident; or why they failed to do what they should have done to prevent it. Only by understanding more clearly the human and organisational factors which caused, or failed to prevent accidents, will we be able to devise more effective preventive strategies.

This thesis primarily reports on a study of 230 fatal accidents which happened in the Agricultural, Horticultural and Forestry industries in Great Britain in the years 1979, 1980, and 1988. The antecedents of these fatal accidents were compared against the modified Hale and Glendon model of accident causation and the results have been fully reported in Chapter 5.

An uninterrupted statistical series running from the beginning of 1979 to the end of 1992 was obtained by extracting common variables from two of HSE's computer systems. Some of the earlier variables were re-coded to match the codings used in the later system, and the data was combined on a spreadsheet. In order to assess the extent to which the results from the study of the three specific years were representative of this longer statistical series, a number of the variables were compared.

7.1 Comparison of the sample population with agricultural accidents over a longer period.

The following discussion should be considered against the background of the methodological issues discussed at the seminar and summarised in section 6.7. Despite these methodological shortcomings substantial information about the causes of agricultural fatal accidents can be drawn from the analysis.

The variables examined were, for each fatality, age, gender, part of body injured, day and month of accident, and the kind of accident. These were the only variables that were common to both the three sample years and to the longer statistical series.

Chapter 5, Table 5.1 shows the distribution of victims by their ages. This distribution had been expected to be very similar in the two populations. However it was found that the proportion of 11 to 15 year olds killed was 10% in the three sample years, but only 3.5% in the 11 other years. This difference is more graphically illustrated by the fact that whilst the Chi-square statistic predicted eight fatalities in this age group in the three sample years, there were 23. There were only 25 more fatalities in this age group in the other eleven years. The over-representation of the 11 to 15 age group in the three sample years is thought to be related to the fact that two of the years occurred relatively early in the period, i.e. 1979, and 1980. The numbers of 11 to 15 years olds killed in earlier years was higher than has been the case more recently. The greater representation of this age group in the sample years may thus reflect the success of the industry in reducing the number of fatalities to this age group during the 1980s. However without details of changes in the population at risk it is impossible to be sure.

The 65 and over age groups was also over-represented, by approximately 30%. This may simply reflect the success of the industry in reducing fatalities to this age group over the fourteen year period. However it is more likely to be a reflection of changes in the population at risk. As previously noted the average age of farmers is rising. Nowadays when a farmer retires the land is divided up among other local farmers and the farmhouse, perhaps with a small parcel of land is sold off. Because of the high capital requirement of the industry it is becoming increasingly difficult for youngsters to break into the industry.

Table 5.2 shows the distribution of the parts of the body sustaining the injury which led to death. It was noted that in more than 20% of the non sample victims, the site of injury was not closely specified. The more detailed analysis of the three sample years recorded slightly higher proportions of injuries involving the neck, spine, ribs, chest, or abdomen when compared with the whole population. This suggests that the information is available to precisely define the site of injury in all but a small proportion of cases but that this information was not being accurately transferred from Inspectors reports into COFFIN, HSE's computerised database of fatal accidents.

Table 5.3 shows a slight over-representation in the three sample years, of accidents that happened in the months of May, September, October and January, and to a lesser extent August. Again this result is consistent with the slightly higher proportion of older children, and over 65 year olds in the sample three years, since these are the main months in which fatalities to people in these age groups would be expected. May because of (a) increased activity on farms (b) lighter evenings and (c) the school Whitsun holidays, which combine to increase the population at risk. More accidents could be expected in August because of the school summer holidays, and in September to October because of the lighter evenings and increased activity arising from the harvesting of cereals and root crops, and the preparation of land for winter cereals.

Tables 5.4 and 5.5 describe the distribution by kind of accident, and compare the non sample and sample years. It was noted that whilst 61 of the fatalities in the sample years were categorised as 'Transport', the Chi-square statistic indicated that 35 should be expected. This was contrasted with the accidents categorised as 'Collapse' where 36 were expected but only 9 observed, and 'Low fall' where although only 9 were expected, 22 were observed. These discrepancies appear to be linked.

For accidents in the larger population, involving runaway tractors, the kind of accident was usually recorded as 'COLLAPSE' since the description of the code includes reference to the deceased being trapped by 'collapsing plant or an overturning vehicle'. This despite the fact that the framework purports to code accidents rather than the injuries sustained as a result of an accident

In the accidents compared against the model, three different scenarios for runaway tractors were identified. The first involved cases where the deceased was on the tractor when it ran away and was injured by striking the inside of the cab or jumped or was thrown clear of the runaway tractor but still sustained fatal injuries. These cases were coded as 'TRANSPORT'. The second scenario involved cases where the deceased fell from the runaway tractor, perhaps whilst trying to mount in order to stop it. In such cases the injuries were usually sustained by being run over. These cases were coded as 'LOW FALL'. The third scenario covered cases where the runaway tractor turned over trapping the deceased. This usually happened where the tractor was not fitted with roll over protection, or where the deceased was ejected or tried to jump but was then crushed between the overturning tractor and the ground. Such cases were recorded as 'COLLAPSE'.

These different scenarios were readily identifiable from the narrative reports, yet the coding framework used for the COFFIN database appears to be too coarse to distinguish them. For the purposes of statistical output it is probably sufficient to be able to identify the number of fatalities that resulted from incidents in which a tractor ran away and overturned. However for accident prevention purposes the distinction between the three scenarios is obviously important.

The number of transport accidents in the three years compared with the model was also swollen by a small number of accidents in 1979 and 1980 which had they happened in later years would have been excluded from the statistics on the grounds that they were Road Traffic Accidents. Changes introduced in the new RIDDOR Regulations mean that some accidents which might have been coded as RTA's in the past may become reportable and be recorded in the occupational statistics. It is anticipated that the annual total of agricultural fatalities will rise slightly.

7.2 Overall findings of the detailed examination of three years fatal accidents.

The detailed comparison of the 230 cases against the accident causation model revealed that the highest proportion of errors leading to accidents happened whilst the victims were operating at the knowledge level. Thus at the time of the accident they were carrying out primarily non routine tasks.

One way in which the agricultural industry differs from other premises based industries such as factories is in the numbers of people who work together. In agriculture, work groups are generally small, and working alone is the norm rather than the exception. The demand for labour fluctuates quite markedly throughout the year depending upon the crops grown, and livestock kept. In the past many farms grew a mixture of crops and kept cattle, sheep or pigs, thus ensuring that their full-time employees were kept fully employed throughout the year. In recent years farmers have tended to simplify their farming systems by specialising in a smaller number of enterprises. As already noted, the services of full-time employees are being dispensed with and replaced by part-time or casual workers, or specialist contractors drafted in to cover busy periods.

This scarcity of workers means that if a machine breaks down on a farm there is generally no readily available mechanic to call upon to carry out repairs. Additionally the weather may provide a further incentive to carry out temporary field repairs, since by the time a mechanic can reach an isolated site the weather may have broken and the 'window of opportunity' to carry out a particular operation may have been missed.

Often the machine operator would be the only person from the farm to have attended the manufacturers training course so would be the one most likely to carry out routine maintenance, and effect simple repairs when the machine breaks down. In the case of the self-employed, the operator may also own the machine, so would be reluctant to call out a mechanic without having first investigated all of the simple solutions. All of this contributed to the 'jack of all trades' ethos of the industry, and may explain why almost half of the proximate failures by the deceased occurred whilst they were carrying out knowledge based tasks. Interestingly a higher proportion of self-employed victims (58%) than employees (38%) were killed as a result of their own errors made whilst operating at the knowledge level of functioning. The overall findings showed that distant failures by the deceased could be identified in only about a quarter of the cases (53).

Only those instances which were self evident or were well documented, were recorded. There were a number of instances in which the existence of a distant failure was suspected but due to lack of evidence, was not recorded. It is thus suspected that this variable may have been under-recorded. Failures distant in time and space from the locus of the accident would not normally be systematically sought out and recorded by investigating Inspectors whose primary interest is in the immediate failures particularly where there is a breach of existing legislation. Examples include bad habits built up over a considerable period where there was a suspicion but no hard evidence that the habit had contributed to the accident happening.

There are at least three different scenarios for the outcome of these distant failures. The failure could cause the accident to happen, it could lead to the failure of a system designed to prevent the accident from happening, or it could contribute to the failure of a system to mitigate the injury.

For example a farmer is to fell a tree and, some time before, has received incorrect instruction in how to do it. He fells the tree using a faulty technique and is killed. The distant failure has caused the accident to happen. Alternatively a tractor mounted winch is being used to support and direct the fall of the tree. However there has been a long term failure to maintain adequately the tractor and winch such that at the crucial moment the winch brake fails to operate correctly, the tree falls in the wrong direction and someone is killed. In this instance the distant failure (to maintain the winch) has led to the failure of a system which would have prevented the accident. In the third example the farmer has available a safety helmet but is in the habit of not wearing it. A correctly felled tree snags against another tree as it falls, a small bough is torn off and falls onto the head of the farmer who is not wearing his safety helmet. Here the distant failure (and proximate failure) to wear the hat has resulted only in the non prevention of the injury. The failure had no effect upon the accident antecedents.

One common feature of the distant failures was that it was usually impossible to decide exactly how long before the accident any particular distant failure had actually occurred. In a few instances it was possible to say that the failure had occurred shortly before the accident happened. Often however the failure had occurred months or weeks before and there may even have been multiple failures. Usually the fact that a failure had occurred was not recognised at the time, or if it was, its significance was underestimated or ignored.

The study examined only fatalities, and few of the victims survived long. Most died at the accident site, although a small number lingered with massive injuries, but without hope of survival. In two cases young victims were kept on life support machines pending organ donation. Some, usually old people died of complications (e.g. thrombosis) some days or weeks after the initial injury. A few received first aid (e.g. a father attempted to resuscitate his daughter with an oxygen mask and cylinder which was present on the farm for the resuscitation of calves). Usually the injuries were so overwhelming or it was so long after the accident that the victim was found that first-aid offered little hope.

Often there was no other person present at the site to render first aid or at least to call for more competent assistance. Where someone else was present their usual first priority was to try to release the victim, but in many cases they didn't know what to do.

7.3 The self-employed

In the case of self-employed people the distribution by month of accident appeared to reflect the distribution of work with peaks in May (11), July (10), and September (11). However there were also 10 self-employed people killed in January, which appears high when compared with December (3), February (4) and March (4). The age distribution tended to be fairly uniform except for an unexpected peak in the 40-44 age band.

Almost 35% of the proximate errors committed by self-employed victims were violations of known rules, and 18% of distant failures involved violations. This suggests that the self-employed have a greater than expected tendency, to take inappropriate risks whilst operating at the knowledge level in situations where they knew or could reasonably have been expected to have known the correct procedure. This possibly reflects a greater propensity among the self-employed, to be working at the knowledge level of functioning (see discussion in Section 7.2 above). Alternative explanations may be that 'familiarity breeds contempt', that victims were testing their skills to the limit, or that they were refusing to acknowledge that they were no longer capable of doing what they could do when younger.

7.4 Employees

The age distribution of employed victims was fairly even except that there were very few victims aged 30 to 45 years. This is probably due to a combination of factors; the numbers at work on farms in this age group is likely to be less than in other age groups, because of low wages; and this age group probably comprises the fittest, most experienced and competent workers on farms.

Just under 40% of the employee victims were killed in accidents that happened whilst they were operating at the skills level. There were two main types of failure. The first (18 cases) was in situations where there was an insistent danger signal to which the deceased responded but was incapable of correctly executing that response. In the second most common situation (12 cases) insistent danger signals were responded to by implementing a known escape procedure, but the deceased failed in the execution of that procedure. Slightly less employees were killed as a result of their knowledge based errors. In 17 cases the need to test for danger was not known, and in 14 cases the problem involved a failure to accept responsibility for taking action to prevent the accident.

In almost 78% of cases an error by the employer of the victim was identified. Over 50% of these errors were at the knowledge level and involved an inability to correctly identify or assess a hazard, suggesting that employers still lack knowledge about the hazards to which their employees may be exposed. In a third of cases an error by a colleague present at the time of the accident was found, those errors most frequently involved a lack of knowledge of hazards.

7.5 Comparison of self-employed with employee victims.

The sample of accidents examined contained the same number of employees as self-employed people, 89 of each. For both employees and the self-employed a high proportion of their proximate failures occurred whilst they were operating at the knowledge level. Fifty-three percent of self-employed people were killed in accidents where their proximate error was knowledge based, whereas for employed people the proportion was only 38%. However in 52% of the cases involving employees it was possible to identify a knowledge based error by their employer.

This confirms the continuing need to direct information and publicity at the industry, aimed particularly at instilling hazard recognition skills into employees, their employers, and the self-employed. During this research a number of areas were identified as warranting greater attention in future publicity. In particular the message that out of the ordinary working situations (when operating at the knowledge level) are more dangerous than normal situations, needs to be publicised, especially to the self-employed. Often it was noted that knowledge based errors occurred when other considerations, such as the need to complete a job before nightfall, assumed too great an importance. This led to a less rigorous consideration of what hazard may be present or even to inappropriate risk taking.

The effect upon the level of risk of changes in the weather has led to problems and should be highlighted in publicity. A number of situations were found in which gradual changes in the weather led to an increase in risk which was so slow as not to be noticed, or was ignored because the task being carried out was almost completed. Examples include an increase in wind speed whilst roofwork was being carried out and increased rainfall that turned a stream into a torrent.

The differences in the percentages of knowledge based errors between the different categories of victims is of interest. As previously discussed it may indicate that the self-employed are more likely to be carrying out knowledge based, problem solving type tasks, than are employees. Alternatively it may be that the health and safety message is being more successfully carried to employees than to either their employers or the self-employed. Further research would be needed to establish whether self-employed people were carrying out a higher proportion of knowledge based tasks than employees, or whether existing health and safety publicity was less effective in targeting them.

Rules based errors accounted for almost a quarter of the proximate failures of employee and of self-employed victims. However in the case of proximate errors that happened at the skills level, the proportion was 39% for employees but only 22% for the self-employed.

Proximate violations by self-employed people were identified in just under 35% of cases, and distant violations in a further 18% of cases. For employees the figures for situations in which their own violations led to the accident, were 25% for proximate failures and just under 15% for distant failures. For employees it was also possible to identify violations by their employers in 30% of cases. Regulations made under the Safety Health and Welfare Provisions Act, 1956 required that employers take precautions to ensure that their employees are safeguarded. They do not require self-employed people to take the same precautions to protect themselves. This dichotomy between the acceptable standards appears to reinforce the 'I'm self-employed so I have the right to kill myself' attitude, a philosophy which appears to be reflected in the above figures.

Whilst operating at the skills level, failures to correctly execute a correctly chosen and known procedure were identified as the proximate failure in 35% of the employee cases, but in only 19% of cases involving the self-employed. This may indicate differences in exposure between the self employed and employees. As already noted with reference to electrocutions, there are certain jobs usually the mundane, routine, boring ones that employees rather than their employers end up doing.

However the age distribution of the two classes of victim was markedly different. The average age of employees was slightly lower than for self-employed victims, 44 compared with 47½ years. The number of self-employed victims in each of the age groups, generally increased with age, except that there was an unexpectedly large number in the 40-44 year age group. The distribution for employees showed peaks for the 16-19 age group, followed by a trough between 30 and 45, and a further peak in the 20 years up to retirement. In 33% of the accidents involving employees and in 36% of cases where the victim was self-employed, there was at least one other person present at the time of the accident. That other person may have been a fellow employee, the employer, a self-employed person, a non-employee, or a child. Being present at the site they could have exercised a beneficial influence on the accident antecedents, yet the accident still happened. The most common failures by other persons present at the site of an accident to employees were knowledge based errors, but for self-employed victims, rule based errors and violations were more common. This may simply reflect differences in authority between the parties present.

7.6 Children aged 0 to 15

In addition to the employees and self-employed people, there were 52 non-employed 'third parties' killed on farms, 45 of whom were children. The examination of the child fatalities revealed that the most common proximate failures happened whilst operating at the knowledge level, where the need to test for danger was not known or recognised. Over 75% of the failures involved the child failing to correctly identify or assess a hazard, often a hazard which would have been self evident to an adult. This is as would be expected in a group comprised primarily of children. Other failures centred on failures to correctly execute escape responses.

In the case of others involved with fatalities to children, the most usual failure on the part of owners of machinery/occupiers of land, and parents involved not accepting responsibility for implementing a known procedure which would have prevented the accident. An example of this may be a case in which a child was being carried on a tractor, (which has been illegal since 1958, a fact which the whole of the agricultural community could be expected to know) and falls through the tractor door when it bursts open whilst travelling over rough ground.

The two most frequent kinds of accident to children were, being hit by a moving vehicle, and drowning. Vehicle accidents were more common among older children present, and sometimes helping at worksites.

Drowning in water was more common among the younger children, especially girls, and drowning in grain, among the older boys. Over the whole period the number of child fatalities has declined from an average of 22 per year in the late 1970s to about 6 per year in the early 1990s. As previously mentioned there are no statistics showing the size of or other variations in the population at risk.

One striking feature of the child fatalities was that children died even when apparently under close supervision. Children riding on tractors driven by a parent fell and were run over before the parent could respond, children present in farmyards went missing for a few minutes and were found drowned, or were butted by a cow which apparently saw them as a threat to a new-born calf. To further reduce child fatalities it will be necessary to segregate children from farmyards at least whilst work is being carried out. It seems unlikely that simply encouraging better supervision will be sufficient.

7.7 Falls from a height

Thirty-nine out of 230 (17%) of accidents involved falls, from one level to another. With most falls, the surface on which the person was standing was stationary immediately before the accident. In some cases the sudden movement of the surface upon which the victim was standing precipitated the accident, in other cases the normal state of the surface was to be in motion, as with falls from moving trailers or machinery. Previous findings by the author (Thomas 1985c) has shown that fatal accidents involving a fall from a stationary surface, are more likely to happen to the over 40s and especially to the over 60s, whereas fatal falls from field machinery were more common among the young especially the 11 to 15 year age group.

Violations of known practices and procedures were implicated in accidents categorised as falls in a high proportion of cases. This is probably simply a reflection of the make-up of the sample of victims, young people falling from machinery where there were violations by their parents and the owners of the machinery, and older people who themselves violated accepted good practice.

7.8 Transport accidents

It has already been pointed out that the number of transport accidents in the three years compared with the model was swollen by a small number of accidents which in later years would have been excluded from the statistics on the grounds that they were Road Traffic Accidents.

The sixty-one cases in which the deceased was struck by a moving vehicle were characterised by skills based errors by the deceased, and knowledge based errors by other parties. In almost half of the cases, it was possible to identify a proximate or distant violation by the deceased. Combining these findings gives the following scenario. The deceased possibly having committed an earlier violation, finds themself in a dangerous position near a vehicle, then fails to make good their escape. Meanwhile some other person probably the driver, moves the vehicle without suspecting that anyone is near it.

7.9 Contact with a falling or swinging object

Thirty-two accidents in which the victim was struck by a falling or swinging object, other than a moving vehicle, were identified. Almost half of the victims were in the age range 40 to 54, and 24 of the accidents happened between November and May suggesting a possible link with bad weather and poor conditions underfoot. Twenty-eight of the accidents happened to the self-employed and employees, and only four to non-employees. The findings indicate that these accidents tend to involve lack of knowledge or skills on the part of the deceased, and other parties, rather than deliberate violations of known good practices. These are the sort of accidents that people simply don't foresee.

7.10 Matrix cell C4 (need to test for danger not recognised)

There were 59 instances in which the proximate failure of the victim was allocated to cell C4, a coding which indicates that the hazard exhibited no obvious warning signs and that the party involved failed to recognise that there was a need to actively seek out danger. The coding of this cell was difficult since in a few cases it was the furthest point on the matrix that could be reached with a reasonable degree of certainty. Some failures should perhaps have been coded as C5 (failure to accept responsibility for testing) or even B6 (correct test not chosen) but because the victim was dead and there were no witnesses, there was no evidence that the victim progressed beyond cell C4.

As would be expected a high proportion of child victims were found in this category. A high percentage of knowledge based errors by other parties was found, indicating that the deceased was not the only one who failed to proactively seek danger. Secondary errors involving violations were rare.

7.11 Matrix cell D2 (correct procedure not known)

There were 37 cases where the proximate failure by the deceased was in cell D2, a coding which indicates that whilst there was an obvious warning, the correct procedure for dealing with the hazard was not known to the deceased. Nineteen accidents involved self-employed or family workers, there were 6 non-employees, and the remaining 12 victims were employees. It was interesting that a higher proportion of farmer victims than employee victims died because they appeared not to know the correct procedure for dealing with an obvious hazard. This again suggests that the farm safety message is more effective in reaching employees than the self-employed.

7.12 Matrix cell E1 (response not correctly executed)

Matrix cell E1 was the most frequently cited kind of proximate error where the deceased was operating at the skills level when the accident happened. Cell E1 refers to the situation in which the danger signal is so obvious and insistent that the victim automatically attempts to escape, but is unsuccessful. Usually the hazard was so extreme that escape would have bordering on the miraculous. Examples would include a charging bull, a tree being felled which twisted and fell off line, and a fire. In many instances the danger signal was very obvious and insistent but only manifested itself shortly before the accident occurred. The docile bull suddenly turns nasty, the fire flashes, the falling tree suddenly twists off line. Whilst the victim automatically tried to escape, the speed with which the danger arose meant that there was insufficient time to get away. The interesting thing from a prevention viewpoint is the high proportion (66%) of these accidents where there was an identifiable earlier failure by the deceased. The average for all accidents was only 23%.

The way to prevent these accidents, which on the face of it appear particularly intractable should be to tackle them through their distant rather than their proximate failures. Better signing and fencing of bull enclosures to prevent access; improved training in tree felling techniques; greater awareness of the inventory of combustibles and of sources of ignition on farms; rather than fitness training so that potential victims can outrun the bull, tree or fire. Isn't this what Heinrich was saying, and isn't it what is now enshrined in the Management Regulations?

7.13 Investigations and reports

Each fatality should be viewed as a resource, the origin of factual information to be aggregated and amplified by information from other sources. Only by gathering, recording, and systematically analysing the data from all fatalities will we learn as much as is possible about accident antecedents. By knowing what is happening, it will be possible to inform and target preventive strategies more accurately

Every fatal accident is different. Inspectors rarely see cases as part of the wider National picture, so information collected is essentially parochial. Locally investigations are concerned primarily with issues specific to that fatality, such as what caused the accident, who was to blame for failing to prevent it, and how do the antecedents of the accident fit with the existing law. Whilst each investigation is carried out in a methodical way it is not done in a way designed to systematically search for and record information that would be of use in a wider context.

Inspectors investigation reports are not designed to be used as a research tool. The reports are written by individual inspectors and reflect their perceptions of accident causation as passed down to them by older Inspectors, and coloured by their subsequent experience. Often the reports contain information presented in such a way as to defend a decision to, or not to, prosecute.

Many of the reports examined appeared to confirm Rasmussen's 'stop-rule' (Rasmussen 1987) '...an event will be accepted as a cause and the search [for further causes] terminated if the causal path can be followed no longer, or a familiar, abnormal event is found which is therefore accepted as explanation, and a cure is known.' There were few cases where there was more than one immediate cause identified by the inspector. Indeed there were cases where the report contained ample evidence of another immediate cause which was not then identified as such in the computerised record of the event.

A good example of this is the influence of alcohol. One tractor overturning case was examined where the deceased's blood alcohol level would have been illegal in a motorist, yet the Inspector blamed unbalanced tyres, there being no mention of alcohol in the computerised version of the accident. In a second case the deceased returned from a Public House after midnight, having been there all evening. He attempted to extricate a tractor which had been left precariously balanced on a silage clamp and turned it over into a slurry pit. Again alcohol was not mentioned on the computerised record of the accident. Often alcohol appears not to have been tested for during post-mortem examinations. It is not thought that alcohol is likely to be a big problem in agricultural accidents, but unless it is routinely test for and the results recorded there is no way of being sure.

Details of the machinery and equipment involved in accidents and its state of guarding in relation to the Regulations made under the 1956 Act was regularly and comprehensively reported upon. Conversely the reports contained little evidence about the adequacy of any information, instruction, training and supervision given to the deceased. The only time that such factors were reported on was when one of them was so inadequate as to lead directly to the accident. The initial analysis of the 20 randomly selected reports suggested that it would be useful to record the experience and training that the deceased had in the job, and in the task being undertaken at the time of the accident. Unfortunately this was not possible since rarely were any objective measures given in Inspectors' reports.

It had been hoped to record information about the length and duration of the shift that the deceased had worked, but the reports were found to contain little objective information on the subject. The time of the accident was routinely recorded but not the time that the deceased started work on the day of the accident. Sometimes a vague statement about fatigue was made if the deceased had worked a particularly long shift.

7.14 Coding and recording the results of investigations

Mention has already been made of the coding of accidents involving runaway tractors, but other coding anomalies were found to exist e.g. similar accidents which because they happened in different years were coded differently. A number of situations were identified in which codes devised for factory situation were unsuitable for agriculture e.g. accidents in which the deceased was killed by a tree or branch could not be separated from those where the deceased was killed by any falling or swinging object.

One variable routinely recorded in Inspectors' reports is the verdict when an inquest is held. Where inquests were held, almost all verdicts were Accident or Misadventure. There seemed to be considerable local variation in what verdict was returned. In some places a verdict of misadventure would be returned on an accident which in another area would attract a verdict of accidental death. In many of the cases examined, largely in Scotland, there was no inquest held. Where inquests were held the verdicts often appeared to say more about the attitudes of local Coroners and juries toward personal responsibilities, than about the way in which the accident happened. There would appear to be little value for accident prevention purposes in recording verdicts.

Chapter 8. Conclusions

8.0 Introduction

This thesis describes a study in which information from existing reports of agricultural fatal accidents, prepared following investigations by experienced Inspectors, was compared against a modified Hale and Glendon accident causation model. The distribution of accidents in the three selected years was compared with accidents that had happened over a longer period and found to be representative. It was possible to distinguish common error modes in groups of victims sharing other common characteristics. However problems were identified when the model was used alone, particularly in relation to the timescale of the accident aetiology. Further problems arose because of a lack of information in the original Inspectors' reports, and it is recommended that future studies be carried out as soon as possible after the start of accident investigations.

8.1 Adequacy of existing data

The data contained in the reports was found to be useful for identifying technical faults relating to the machinery and equipment involved in the accidents. The reports were less helpful to a researcher seeking information about human factors aspects of accident causation. In cases where reports were incomplete the researcher had to make reasonable presumptions about what actually happened.

It had been hoped to examine the contribution to the accident antecedents of variables related to the information, instruction, training and supervision of the victims. However very little information on these factors was recorded in the Inspectors' reports, and it is recommended that in future, such information be routinely sought and recorded.

One area in which further information could usefully be collected concerns the possible involvement of alcohol in some accidents. It appears from Inspectors' reports that post mortem examinations do not routinely include a determination of blood alcohol content.

8.2 Investigation

Investigations carried out by Inspectors are intended principally to establish how and why the deceased was killed, what health and safety legislation applied to those circumstances, and who was responsible. Inspectors are also concerned to collect appropriate evidence so that any malefactors can be brought before the courts for punishment. Inspectors are not primarily concerned with the collection of facts which may be of use in subsequent research.

A number of facts about each accident are routinely collected, and stored, but the reporting system does not encourage the collection in a structured way of information about the errors made by individuals, as they operate within organisations.

Historically inspectors have learned about investigation techniques by observing senior colleagues then applying what they have learned. It is only in the past decade that trainee Inspectors have received a theoretical grounding in accident causation modelling, and accident investigation techniques as part of their initial training. More recently large numbers of older Inspectors have received similar training. It is time that Inspectors were actively encouraged to use accident causation models as part of their normal armoury of investigative tools. It is also recommended that Inspectors be given more information about the actual and potential uses of the data which they collect.

8.3 Reporting by Inspectors'

In some cases Inspectors reports appeared to be written in such a way as to justify decisions about subsequent enforcement action. Also many appeared to have been written with the thought at the back of the authors' mind that they might at some later date be disclosed in legal proceedings.

The quality and comprehensiveness of the reports studied was found to be very variable. Those reports which were most useful for the purpose of accident analysis were those which contained a straightforward presentation of the facts, followed by a candid exposition of the circumstances in the light of the investigating Inspectors' experience. Potentially useful information sometimes remained unrecorded, particularly the information that a particular facet was explored but not found to be significant. It is recommended that Inspectors be encouraged to record such information.

8.4 Coding of accidents/ storage of information

Instances were found where the HSE coding framework was less than helpful for recording information which would be useful in any subsequent analyses of the data. In particular it is recommended that the coding framework be amended to more specifically cover multi-causality and human factors. It should also be made more generic and less industry specific.

Some problems were noted in the consistency of coding over time, which could be addressed by more comprehensive monitoring and auditing of the reports, perhaps combined with comparisons with samples of witness statements and coroners' notes. What is needed to be recorded for the purpose of analysis, is accurate comprehensive information based upon facts, and upon an objective assessment of the situation by the investigating

Inspector. To encourage a frank expression of views it will be necessary to store the information in such a way that it cannot be disclosed subsequently.

8.5 Analysis of accidents

Currently fatal accidents are analysed by comparing variable such as employment status, kind of accident, day, date, county etc. and the information published annually. Other ad hoc analyses take place for instance in response to parliamentary questions, or to establish the number of accidents in which a particular make or model of machine has been involved. There are currently no analysis carried out to establish what are the common error modes of those involved in accidents.

If the information were collected by Inspectors and stored in a computerised expert system devised for the purpose, such analyses could be regularly updated. Such a system in addition to recording and routinely analysing the data would act as training tool for Inspectors.

Other supplementary information gained from commissioned research or from studying similar accident which had not proved fatal could also be fed in to the system, with outputs being routinely circulated to inform Inspectors.

8.6 Design of interventions

Historically the Agricultural inspectorate has made a number of interventions designed to address particular categories of accidents (e.g. Mr Scarekid) or to increase the general level of knowledge within the industry about hazards (e.g. Farmwise (Health and Safety Executive 1992c)). This research has shown that there is a continuing place for such interventions, particularly to address those accidents where a lack of knowledge is implicated. However in many instances those involved were aware of the hazard, but lacked the correct motivation to implement the correct procedure to prevent harm occurring. It is recommended that further research be carried out to discover what motivates farmers to engage in safe, or unsafe behaviour.

If we are to further significantly reduce accidents in the industry it will be necessary to define precisely the population to be targeted during interventions, and to identify the form that those interventions should take. For example:

- to address the problem of self-employed committing violations of good practice it may be appropriate to target their spouses;

- to reduce accidents to youths, more training in hazard spotting would be appropriate;

- to reduce accidents to employed persons it would be advisable to provide training for employers, in how to identify, assess and control hazards, and to manage residual risk. Training farmers in how to translate the theory of risk assessment into practical accident prevention measures would also raise their awareness of health and safety issues.

- to reduce accidents particularly to the self-employed, arising from knowledge based failures, the increased level of risk during non-routine working situations should be highlighted;

- to reduce accidents where the immediate failure involves a lack of skill, it would be appropriate to attack distant failures, to try and ensure that the level of risk arising from the hazard is and remains, controlled;

Having applied the intervention it will be necessary, as at present, to measure the effects of that intervention and to evaluate its effectiveness. It is unlikely that effects would be reflected in the number of fatal accidents in the industry, at least in the short term, so evaluation would need to be by surveys.

8.7 Further research

This study has shown that it is possible with appropriate modification to use the Hale and Glendon model of accident causation to retrospectively analyse agricultural fatal accidents and to obtain insights into the reasons why such accidents happen. There are however some differences between the agricultural and other sectors of British industry (e.g. the size of the self employed contingent, and the number of children and old people placed at risk by the industry's activities) which mean that the results may not be directly applicable to other industries.

It is recommended that the technique be used in conjunction with Events and Causal Factors Analysis to study fatalities in other industries, such as Construction and Manufacturing. The techniques should be applied at the time of the initial accident investigation to avoid losing valuable information. It would also be useful to apply the techniques to non-fatal accidents, and to loss incidents, where the witnesses and any victims are available for interview. A comparison of the results obtained from studies of fatal and non-fatal accidents would indicate whether or not there were any differences between their antecedents.

8.8 Summary

It is difficult to summarise the wealth of findings of this Hale-Glendon coding study. The following general conclusions about agricultural fatal accidents may be drawn:

(i) that the self employed are more likely than employees to have committed a violation of good practice, leading to the accident;

(ii) that a high proportion of failures by the self-employed occurred whilst operating at the knowledge based level;

(iii) in some cases it appears that young people fail to recognise a hazard which their elders think it so obvious that they don't mention it;

(iv) children are more likely to have an accident as a result of their lack of knowledge of the existing hazards;

(v) children can be killed even when under the closest of supervision by a parent;

(vi) publicity should be directed at informing the industry of the need to follow risk assessments principals particularly in out of the ordinary working situations which are more dangerous than routine tasks;

(vii) research is required to establish the exact nature of and reasons for violations of good practice, particularly by the self employed;

(viii) the problem of violations should be addressed by greater enforcement in the short term and in the long term by shifting industry opinion away from risk taking;

In addition the following recommendations are made concerning the way in which agricultural fatal accidents are investigated, and the results of investigations are recorded:

(i) Inspectors should be encouraged to make greater use of Events and Causal Factors Analyses, accident causation models, and other techniques to systematically identify all failures;

(ii) human factors information should be systematically sought out recorded, and analysed;

(iii) greater efforts should be made to identify and record distant (latent) failures as it is often only through the prevention of these that the accident can be stopped.

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Appendix 1

Narrative texts and accident matrix coding of the 230 agricultural fatal accidents examined for the purposes of this research.

(Note that the initial sample of 20 randomly selected cases were numbered from 1 to 20. The 230 cases in the three selected years were numbered from 21. Case 8 was the only one in both selections. Following the allocation of numbers, several cases were excluded, where death was due to a chronic disease)

Case No 8

The 40 year old son of a farmer was assisting his father who was ill, by grinding some corn using a roller mill. A blockage occurred in the inadequately guarded mill, and in attempting to clear it the deceased's woollen pullover became caught on the rusty drive shaft, and strangled him.

Coding:

Deceased	D2 - Correct procedure not known.
Colleague (employed)	D2 - Correct procedure not known.
Machine owner	C7 - Responsibility for action not accepted/allocated.

Case No 21

The 16 year old son of a farmer entered the lower hatch of a moist grain silo in an attempt to rescue his father's employee who had been overcome after entering the silo through the top hatch. The silo had been ventilated by leaving the top hatch only, open for several hours. The danger of gas was known but it was not appreciated that the gas was heavy.

Coding:

Deceased	D2 - Correct procedure not known.
Owner of building	D2 - Correct procedure not known.
Employee	D2 - Correct procedure not known.

Case No 22

A 13 year old boy was visiting a schoolfriend for the weekend. He was playing with a loaded .410 shotgun when it discharged.

Coding:

Deceased	D3 - Correct procedure not chosen.
Owner of equipment	C3 - Responsibility for implementing procedure not accepted.
Colleague (child)	C4 - Need to test for danger not known/recognised.
Parent	C3 - Responsibility for implementing procedure not accepted.

Case No 23

A 64 year old general farm worker was working with his son and his employer's son grading potatoes when an adjacent stack (five high) of full potato boxes fell upon him.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	C4 - Need to test for danger not known/recognised.
Manufacturer	C6 - Need for action not recognised.

Case No 24

An 18 year old general farm worker was filling a hopper above a roller mill, with barley. He jumped up onto a steel roof truss to look into the hopper and was electrocuted. The electrical installation on the farm was poor and badly maintained.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	C4 - Need to test for danger not known/recognised.
Supplier installer	C4 - Need to test for danger not known/recognised.

Case No 25

A 17 year old employed farmer's son driving a tractor and four wheeled trailer (unbraked) down a 1:10 slope in icy conditions. Traction was lost and the tractor overturned into a stream trapping the deceased under water. The deceased was an inexperienced driver although he had passed his tractor driving test, and the weather conditions were atrocious with ice beneath snow.

Coding:

Deceased	A1 - Correct response not in programme.
Deceased	D2 - Correct procedure not known.
Employer	C6 - Need for action not recognised.
Employee	C6 - Need for action not recognised.

Case No 26

A 41 year old tractor driver was sent to clear flood water using a slurry tanker with an unguarded power take-off shaft on which he became entangled whilst operating the controls. The guard was available and the deceased and a mechanic had been instructed to fit it.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Employer	E3 - Procedure not correctly executed.
Colleague	C3 - Responsibility for implementing procedure not accepted.

Case No 27

22 year old conscientious steady farm worker turned a root feeder trailer over on to its side. In attempting to right it he stood in the bucket of a loader tractor, to force the trailer chassis down. The chassis went down and the trailer bed descended trapping him. The tipping trailer was badly designed by the farmer. The bed tipped too far causing the weight of the bed to pull the ram out.

Coding:

Deceased	D7 - Correct plan/procedure not chosen.
Employer	C4 - Need to test for danger not known/recognised.

Case No 28

A group of youths (12-14 years old) were sliding on ice on a 2-3 acre disused slurry lagoon adjacent to a public park and footpath. Three fell through and one drowned. One was rescued by his brother and one by the farmer at great personal risk. Part of the lagoon had been fenced but the fence had fallen into disrepair.

Coding:

Deceased	B6 - Correct test not chosen and correctly executed.
Owner of land	E3 - Procedure not correctly executed.
Colleague	B6 - Correct test not chosen and correctly executed.
HSE	D7 - Correct plan/procedure not chosen.

Case No 30

A 32 year old experienced tractor driver was removing manure from a covered cattle yard using a Massey Ferguson 35 tractor and MIL loader. The tractor safety frame extended to 7ft high and the doorway to the covered yard was only 6ft 6in. As the tractor entered the yard the frame dislodged a concrete door lintel which fell killing the driver.

Coding:

Deceased	D2 - Correct procedure not known.
Employer	C5 - Responsibility for testing not accepted.

Case No 31

The 26 year old son of a farmer was driving a crawler tractor towing a loaded two wheeled trailer across a frozen slope. Frequent earlier sideways slips had occurred before the outfit finally slipped over an 8ft embankment.

Coding:

Deceased	E3 - Procedure not correctly executed.
Employer	C6 - Need for action not recognised.

Case No 32

A 70 year old part-time worker was using a 9 rung wooden ladder to gain access to a compost hopper on a machine on a mushroom farm. The ladder slipped and the deceased fell receiving a hairline fracture of his pelvis. He died six days later from a pulmonary embolism.

Coding:

Deceased	B6 - Correct test not chosen and correctly executed.
Employer	C7 - Responsibility for action not accepted/allocated.
Designer	C6 - Need for action not recognised.

Case No 33

A 4 year old girl was playing alone in a barn swinging from baler twine suspended from a beam. The rope slipped around her neck and the child hanged.

Coding:

Deceased	A1 - Correct response not in programme.
Owner of building	C5 - Responsibility for testing not accepted.
Parent	C5 - Responsibility for testing not accepted.

Case No 34

A 27 year old agricultural contractor was putting right his own previous faulty workmanship in erecting a fence. Whilst attempting to cross a flooded stream he was swept away. The water level had been rising during the work but the speed and degree of increase in the danger was under estimated.

Coding:

Deceased	C6 - Need for action not recognised.
Colleague	C6 - Need for action not recognised.

Case No 35

An 11 year old boy was playing with his cousin removing stones from a wall of an old building when it collapsed burying him.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Owner of building	C5 - Responsibility for testing not accepted.
Parent	C5 - Responsibility for testing not accepted.
Colleague (child)	C4 - Need to test for danger not known/recognised.

Case No 36

A 15 year old educationally subnormal boy was assisting unpaid, on a farm. As part of a land reclamation project he drove a loaded dumper truck to a river bank intending to tip the contents. The truck slid 2 metres down a 3 metre bank then overturned forwards, trapping the deceased under it. The post mortem revealed that a heart attack may have happened but this was possibly as a result of the accident.

Coding:

Deceased	E3 - Procedure not correctly executed.
Owner of machine	C6 - Need for action not recognised.

Case No 37

A 42 year old company director and part-time smallholder was attempting to extract a bogged down tractor by towing it using a tractor without roll-over protection. The deceased hitched a wire rope to the top link of the tractor and whilst pulling the tractor overturned.

Coding:

Deceased	A1 - Correct response not in programme.
Deceased	C4 - Need to test for danger not known/recognised.

Case No 38

A 66 year old farmer who was about to sell up and retire was found drowned in a river running alongside his field. No explanation as to how he came to be in the river but he may have been inspecting his stock.

Coding:

Deceased	E3 - Procedure not correctly executed.

Case No 39

A 43 year old farmer was repairing fencing when he was found dead with gunshot wounds. The circumstances were consistent with an accident and inconsistent with suicide although the deceased was known to be upset over the death of his son some years before. The gun was used to shoot dogs known to be worrying sheep. The deceased probably slipped whilst carrying the shot gun.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 40

A 76 year old semi-retired senior farm partner was ploughing using a Fordson tractor fitted with a weather cab only. Whilst ploughing short lengths, he reversed in order to turn when the tractor ran away down the slope and then sideways across a bank onto the seashore. The tractor rolled over through 360° and the deceased was found dead of crush injuries inside the flattened cab.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	D2 - Correct procedure not known.
Machine owner	C3 - Responsibility for implementing procedure not accepted.

Case No 41

A frail 81 year old man (a keen gardener) was attempting to drive a group of yearling cattle away from the vicinity of his garden when he was knocked down and trampled. He died 6 hours later from bleeding in his lungs due to fractured ribs.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Animal owner	C3 - Responsibility for implementing procedure not accepted.

Case No 42

A 58 year old self-employed farmer was using a stationary slurry tanker. The power take-off shaft was guarded, but not 2 inches of the power input connector upon which his clothing became wound. The deceased was asphyxiated. The power input connector guard had been removed because of problems with a Vee belt drive.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 44

A 65 year old self-employed farmer was driving a tractor without a safety cab on a 1 in 3 slope in wet muddy conditions. The nearside wheel dropped into an old track causing the tractor to overturn onto its nearside trapping the deceased beneath the rear wheel. An inspector had carried out a field inspection a year before and advised the deceased to fit a roll bar.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 45

A 45 year old experienced self-employed forestry contractor was driving a tractor across a slope whilst removing logs, when it suffered a multiple overturn. The deceased died 5 days later of liver and kidney injuries. The top half of the roll bar had been removed in order to fit a weather cab.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 46

The 15 year old son of a smallholder/publican was assisting by using an electric drill to sand a ploughshare. There were faults in the electrical installation which resulted in the metal casing of the hand drill becoming live and the boy was electrocuted.

Coding:

Deceased	D2 - Correct procedure not known.
Parent	E3 - Procedure not correctly executed.
Owner of equipment	E3 - Procedure not correctly executed.

Case No 47

The 19 year old son of a farmer who was apparently aware of the dangers, entered a sealed grain silo from the top in order to clear grain from inside the lower hatch, so that it could be opened to let out carbon dioxide. He was overcome and asphyxiated. The grain had bridged leading to the need to clear it.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Owner of equipment	C3 - Responsibility for implementing procedure not accepted.
Colleague	C3 - Responsibility for implementing procedure not accepted.

Case No 48

The 11 year old son of a farmer rode on a tractor drawn roller (driven by his 15 year old brother). He fell and was run over by the half tonne roller. He had previously been told to get off the roller by his father and had complied, subsequently remounting.

Coding:

Deceased	C7 - Responsibility for action not accepted/allocated.
Parent	E7 - Plan/procedure not correctly executed.
Owner of machine	E7 - Plan/procedure not correctly executed.
Colleague (child)	E7 - Plan/procedure not correctly executed.

Case No 49

A 58 year old stockman was apparently butted by a Friesian bull sustaining chest injuries and exacerbated a pre-existing hernia condition. Subsequently he was operated on for the hernia but contracted peritonitis and died of pneumonia.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Employer	C3 - Responsibility for implementing procedure not accepted.

Case No 50

The 14 year old son of a smallholder was driving a tractor, a small Kubota in reverse when he overturned it into a ditch, becoming trapped beneath the rear nearside wheel.

Coding:

Deceased	D2 - Correct procedure not known.
Equipment owner	C7 - Responsibility for action not accepted/allocated.
Parent	C7 - Responsibility for action not accepted/allocated.

Case No 51

A 47 year old experienced forester was felling three small trees growing from a common base. The middle-sized tree became hung-up against the largest. In attempting to take down the hung-up tree it fell on him.

Coding:

Deceased	D2 - Correct procedure not known.
Deceased	A1 - Correct response not in programme.
Employer	C6 - Need for action not recognised.

Case No 52

A 3 year old boy was taken into a loose box by his father, a farmer, to assist in feeding a Friesian cow with a four-day old calf. The startled cow butted the child rupturing his liver.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.

Parent	C3 - Responsibility for implementing procedure not accepted.
Owner of animal	C3 - Responsibility for implementing procedure not accepted.

<u>**Case No 53**</u>

A 76 year old farmer was assisting by throwing bales from a silage clamp into a manger when he apparently tripped falling about 5ft and fracturing his neck. He died 13 days later from an infection resulting from his injuries.

Coding:

Deceased	E1 - Response not correctly executed.
Owner of buildings	D2 - Correct procedure not known.

<u>**Case No 54**</u>

A 48 year old self-employed farmer was carrying a loaded shotgun up a steep hillside in damp slippery conditions wearing footwear with little tread on it. He is thought to have hit his head, subsequently using his gun (barrel uppermost) to support himself when it discharged into the left side of his chest.

Coding:

Deceased	A1 - Correct response not in programme.
Deceased	C3 - Responsibility for implementing procedure not accepted.

<u>**Case No 55**</u>

A 14 year old boy was riding on the drawbar of a tractor drawn roller driven by an untrained 15 year old. The deceased fell from the drawbar hitting his head on the roll and died four days later from a cerebral haemorrhage.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Parent	C4 - Need to test for danger not known/recognised.
Owner of equipment	C7 - Responsibility for action not accepted/allocated.
Colleague	C4 - Need to test for danger not known/recognised.

Case No 56

The 31 year old pilot of a crop spraying aircraft was killed when it crashed and caught alight. In attempting to climb after spraying beneath power cables one wing tip caught a tree which caused the crash.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	B6 - Correct test not chosen and correctly executed.
Employer	B6 - Correct test not chosen and correctly executed.

Case No 57

A 63 year old farm worker was sent to sweep out dust in a grain dryer building. He was found dead having fallen through the hardboard dust cover on a 20ft high grain bin. The catwalk was well guarded, but the deceased may have reached over or under a guard rail. A pre-existing medical condition may have caused dizziness.

Coding:

Deceased	E3 - Procedure not correctly executed.
Employer	D7 - Correct plan/procedure not chosen.

Case No 58

A 68 year old semi-retired general farm worker was driving a tractor fitted with a quiet cab. Whilst attempting to turn downhill with a mounted harrow (linkage chains slack) in a gently sloping field, he turned too tightly (possibly because of unfamiliarity with power steering) and the tractor overturned through 180° coming to rest in an unstable state on its roof. The deceased escaped and whilst lying on the ground to recover, the tractor toppled over onto him.

Coding:

Deceased	E1 - Response not correctly executed.
Employer	C4 - Need to test for danger not known/recognised.

Case No 59

A 24 year old farmer was working under time pressure to connect up the electricity supply to sheep shearing equipment when he was electrocuted. An earth fault in an adapter cable (three pin round to three pin square) caused the metal extension cable drum which he was holding to become energised at mains voltage (240v).

Coding:

Deceased	D2 - Correct procedure not known.
Owner of equipment	D3 - Correct procedure not chosen.
Colleague	D2 - Correct procedure not known.
Supplier (services)	E3 - Procedure not correctly executed.

Case No 60

A 20 year old self-employed agricultural contractor was driving a poorly maintained tractor with linked but unbalanced brakes, down a gently sloping grass field. The tractor skidded out of control and overturned through 270^{o} on to its side, trapping the deceased beneath the rear wheel.

Coding:

Deceased	E1 - Response not correctly executed.
Owner of equipment	C3 - Responsibility for implementing procedure not accepted.

Case No 61

A 67 year old semi-retired part-time farm mechanic trapped his hand and arm in the contra-rotating roller/web on a potato harvester. He died three days later of a cerebral haemorrhage probably as a result of his injuries.

Coding:

Deceased	D3 - Correct procedure not chosen.
Owner of equipment	E7 - Plan/procedure not correctly executed.

Case No 62

A 44 year old self-employed farmer went to check a field of cattle including a Charolais bull. The bull gored him leading to death approximately 6 hours later.

Coding:

Deceased	D3 - Correct procedure not chosen.

Case No 63

A 62 year old extremely experienced and skilled tree feller felled a 106ft Douglas Fir which in falling sheared off a branch from an adjacent beech tree. This branch fell vertically sticking into the ground and whilst the deceased was cutting a path towards it; it fell striking him on the head and killing him instantly despite him wearing a safety helmet.

Coding:

Deceased	D3 - Correct procedure not chosen.
Colleague	D3 - Correct procedure not chosen.

Case No 64

A 38 year old farm worker was attempting to tow a bogged down tractor using an uncabbed tractor, and with the tow cable attached to the top link. The tractor overturned rearwards trapping the deceased beneath it.

Coding:

Deceased	B6 - Correct test not chosen and correctly executed.
Deceased	D2 - Correct procedure not known.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Employer	C5 - Responsibility for testing not accepted.
Colleague	C4 - Need to test for danger not known/recognised.

Case No 65

A 5 year old child apparently fell from a tractor driven by her father, and was run over. Evidence conflicts.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Owner of equipment	C3 - Responsibility for implementing procedure not accepted.
Parent	C3 - Responsibility for implementing procedure not accepted.

Case No 66

A 59 year old head tractor driver was trapped between the sprayer and the tractor mudguard. He lifted the sprayer on the tractor's hydraulics, whilst attempting to remove the top link pin.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	C4 - Need to test for danger not known/recognised.

Case No 68

A 53 year old self-employed farmer went pigeon shooting. Whilst removing a loaded shotgun from his Land Rover the gun discharged into his face when the trigger fouled the brake lever.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 69

A 10 year old girl visiting a 'Pick Your Own' farm was being conveyed on a low loader trailer from one part of the farm to another. She appears to have decided to jump off, and on landing, fell back under the trailer wheel.

Coding:

Deceased	A1 - Correct response not in programme.
Owner of equipment	E7 - Plan/procedure not correctly executed.
Parent	C3 - Responsibility for implementing procedure not accepted.
Colleague	E1 - Response not correctly executed.

Case No 70

A 55 year old farmer was driving a tractor fitted with a quiet cab down a road with a 1 in 7 slope. It was covered in 12 inches of snow with ice on top. The towed, loaded trailer had defective brakes and pushed the tractor whose brakes could not restrain the combination on the icy surface. The tractor-trailer combination jack-knifed, and the tractor turned over onto its nearside. The farmer tried to jump and was trapped in the doorway.

Coding:

Deceased	C7 - Responsibility for action not accepted/allocated.
Deceased	D2 - Correct procedure not known.

Case No 71

A 59 year old farmer was riding on the bonnet of a slow moving Land Rover following a flock of sheep which were being moved along an unclassified road. He fell or attempted to dismount and was run over by the Land Rover which was driven by his wife.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Colleague (wife)	E1 - Response not correctly executed.

Case No 72

A 12 year old farmer's son was riding between the seat and the nearside mudguard of an uncabbed tractor which was being driven by his father. Whilst ascending a hill his father missed a gear, the tractor ran backwards and overturned onto its nearside through 180° trapping the deceased beneath it.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Equipment owner	C3 - Responsibility for implementing procedure not accepted.
Parent	C3 - Responsibility for implementing procedure not accepted.

Case No 73

A 28 year old farmer was disconnecting a slurry tanker from a tractor. He parked the tanker on slightly sloping ground. On removing the drawbar pin the tanker rolled forwards trapping the deceased by his lower chest between the tanker's handbrake and the rear nearside tractor wheel. The manufacturer's drawbar jack was available but not used.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Manufacturer	E7 - Plan/procedure not correctly executed.

Case No 74

A 40 year old farmer was working with a neighbour baling straw using a Massey Ferguson 20-8 baler. Whilst attempting to relocate the pickup drive chain on to its sprocket he asked his friend to engage the power take-off drive, whereupon his neck was crushed between the baler plunger crank and the drawbar.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Colleague	C4 - Need to test for danger not known/recognised.

Case No 75

A 22 year old employed farmer's son was operating a big baler. He attempted to clear a blockage in the pickup and was drawn into the bale chamber.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Machine owner	C5 - Responsibility for testing not accepted.

Case No 76

Unbeknown to the farmer five young boys had entered a barn and were playing with straw bales. The older two went further into a den whereupon a fire broke out and they were overcome by carbon monoxide fumes.

Coding:

Deceased	A1 - Correct response not in programme.
Building owner	C6 - Need for action not recognised.

Case No 77

Unbeknown to the farmer five young boys had entered a barn and were playing with straw bales. The older two went further into a den whereupon a fire broke out and they were overcome by carbon monoxide fumes.

Coding:

Deceased	A1 - Correct response not in programme.
Building owner	C6 - Need for action not recognised.

Case No 78

A 31 year old farmer entered the grain tank of a John Deere 630 combine harvester, for reasons unknown He became entangled and strangled on the levelling auger.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Manufacturer	C7 - Responsibility for action not accepted/allocated.

Case No 79

Whilst carrying one end of a trailer tailgate between two trailers, one of the trailers moved striking the far end of the tailgate causing the deceased (a 51 year old general farm worker) to be crushed between the trailer and the tailgate, breaking his right leg. He subsequently died of a pulmonary embolism.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	C4 - Need to test for danger not known/recognised.
Colleague (self-empl'd)	C4 - Need to test for danger not known/recognised.

Case No 80

The 2 year old son of a farmer was left alone for a short period outside the farmhouse. He wandered around the outside of some farm buildings for over 100 yards before walking into a slurry pit and drowning.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Parent	C6 - Need for action not recognised.
Owner of land	E7 - Plan/procedure not correctly executed.

Case No 81

A 10 year old boy was allowed to assist with bale carting. While sitting on a low trailer emptying straw from his shoe he tried to pull himself upright by holding on to the trailer rave which was hinged. It fell trapping him by the chest. He was extricated quickly but died that night of chest injuries.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Owner of equipment	C5 - Responsibility for testing not accepted.
Colleague	C4 - Need to test for danger not known/recognised.

Case No 82

A 6 year old farmer's son was watching his father filling a silage clamp. He became buried by grass and was asphyxiated.

Coding:

Deceased	A1 - Correct response not in programme.
Parent	C6 - Need for action not recognised.
Equipment owner	C6 - Need for action not recognised.

Case No 83

A 12½ year old boy was driving a tractor with a rear mounted mower, cutting thistles for a friend of his father. The tractor ran backwards through a hedge and overturned into a ditch trapping the deceased. The tractor brakes were defective and the rollbar was not fitted.

Coding

Deceased	A1 - Correct response not in programme.
Machine owner	C3 - Responsibility for implementing procedure not accepted.
Parent	C3 - Responsibility for implementing procedure not accepted.

Case No 84

A 14 year old casual worker on a potato harvester was riding on the offside mounting step trailing a foot on the wheel, when he fell and was run over by the harvester.

Coding:

Deceased	A1 - Correct response not in programme.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Machine owner	C4 - Need to test for danger not known/recognised.
Colleague	C6 - Need for action not recognised.

Case No 85

A 40 year old farm worker was attempting to close the lid on the top of a combined harvester grain tank when he slipped from the ledge he was standing on. He fell 11ft and injured his neck. The deceased became paralysed and died of bronchopneumonia two weeks later.

Coding:

Deceased	D2 - Correct procedure not known.
Employer	D2 - Correct procedure not known.
Manufacturer	C3 - Responsibility for implementing procedure not accepted.

Case No 86

A 17 year old gypsy, a casual worker on a hop farm was driving a tractor without rollover protection at excessive speed. He was carrying his 10 year old brother as a passenger. He failed to negotiate a bend in the concrete farm track, the tractor overturned through 180° and he died of head injuries. His brother fell clear receiving superficial injuries.

Coding:

Deceased	A1 - Correct response not in programme.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Machine owner	C3 - Responsibility for implementing procedure not accepted.

Case No 87

A 66 year old retired cowman agreed to work part-time with a friend milking cows for two days in a farmer's absence. Whilst tying up cows in a shippen he apparently fell striking his head, and fracturing his skull.

Coding:

Deceased	C6 - Need for action not recognised.
Colleague	C6 - Need for action not recognised.

Case No 88

A 61 year old general farm worker was operating a slurry tanker with an unguarded power take-off shaft. He became caught by his clothing.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Employer	E3 - Procedure not correctly executed.

Case No 89

The 68 year old deceased worked part-time in a vineyard in return for accommodation. Whilst testing a small vineyard tractor which had undergone repair it ran backwards over the edge of a terrace, trapping him and fracturing his pelvis. Crucially the movement of the deceased's left foot was thought to have been impaired prior to the accident, by the combined effects of diabetes and thrombosis.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Machine owner	E7 - Plan/procedure not correctly executed.

Case No 90

A 69 year old farmer was felling a disused elm tree. The tree fell twisting sideways, trapping the deceased by his chest when the branches hit the ground. The felling technique was faulty and the deceased had failed to clear an escape route.

Coding:

Deceased	D2 - Correct procedure not known.
Colleague	D2 - Correct procedure not known.

Case No 91

A 75 year old casual farm worker fell approximately 2 metres from the top of a silage clamp onto a concrete floor, whilst searching for a good bale of hay for calves at 8.30 p.m. one night. He died 2 months later of bronchopneumonia arising from spinal injuries.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Owner of machine	E3 - Procedure not correctly executed.

Case No 92

The deceased a 13 year old boy was sitting on the offside mudguard of a tractor with his head outside the safety frame. The tractor involved was a Massey Ferguson 135 which was being driven by his 13 year old friend. The boys were skylarking and the tractor was being driven in tight circles during which it overturned trapping the deceased under the frame.

Coding:

Deceased	D2 - Correct procedure not known.
Colleague (child)	D2 - Correct procedure not known.
Employer	C5 - Responsibility for testing not accepted.

Case No 93

The deceased a 17 year old assistant was overcome by carbon monoxide fumes whilst loading bales into a barn. It is thought that straw and chaff falling on to the engine of a petrol driven elevator ignited on the exhaust and the two deceaseds were trapped between the straw stack and the roof of the barn.

Coding:

Deceased	D2 - Correct procedure not known.
Employer	C6 - Need for action not recognised.
Colleague (deceased)	D2 - Correct procedure not known.
Manufacturer	B6 - Correct test not chosen and correctly executed.

Case No 94

The deceased a 48 year old farm worker was overcome by carbon monoxide fumes whilst loading bales into a barn. It is thought that straw and chaff falling on to the engine of a petrol driven elevator ignited on the exhaust and the two deceaseds were trapped between the straw stack and the roof of the barn.

Coding:

Deceased	D2 - Correct procedure not known.
Employer	C6 - Need for action not recognised.
Colleague (deceased)	D2 - Correct procedure not known.
Manufacturer	B6 - Correct test not chosen and correctly executed.

Case No 95

A 3 year old daughter of traveller parents was present in the field where potatoes were being lifted by hand into 1-ton potato boxes. The boxes were advanced across the field as the rows were cleared. The child went missing and was discovered under a partly filled box containing 14-15 hundredweight of potatoes.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Parent	E3 - Procedure not correctly executed.
Owner of machine	D2 - Correct procedure not known.

Case No 96

A 38 year old tree feller was driving an uncabbed tractor across a 30° slope whilst extracting a beech tree trunk. The trunk rolled away downhill dragging the tractor over through 180° and trapping the deceased beneath.

Coding:

Deceased	D2 - Correct procedure not known.
Employer	C3 - Responsibility for implementing procedure not accepted.

Case No 97

An 85 year old retired farm worker was assisting the farmer, his nephew by marriage, to collect sheaves and carting them back to the farm. Whilst travelling on top of the sheaves he fell approximately 6ft onto frozen ground fracturing his neck.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Owner of machine	C3 - Responsibility for implementing procedure not accepted.

Case No 98

A three year old girl was being supervised by a family friend who took her to a field where she was employed to harvest potatoes by hand. Boxes were being moved towards the potato rows as the harvested area advanced across the field and one was placed on the child who was thought to have been sitting behind it.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Parent	C4 - Need to test for danger not known/recognised.
Equipment owner	C3 - Responsibility for implementing procedure not accepted.

Case No 99

While using a McConnell digger attached to a Massey Ferguson 35 tractor to push boughs into a hedge bottom the deceased became trapped between the control console of the digger and the rear cross-member of the safety cab.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	C4 - Need to test for danger not known/recognised.
HSE	E7 - Plan/procedure not correctly executed.
Manufacturer	E7 - Plan/procedure not correctly executed.

Case No 100

Whilst driving a tractor on a sloping track the deceased a 72 year old male dismounted to open a gate. Having failed to fully apply the handbrake the tractor ran forward over him.

Coding:

Deceased	E3 - Procedure not correctly executed.

Case No 101

The deceased was using a tractor mounted winch to extract a windblown tree from a gully. He failed to check that the tree trunk was detached from its roots. The winch wire was attached to the top of the tree but as its roots still anchored the tree in the ground the tractor was pulled over sideways then dragged backwards with the deceased still under it.

Coding:

Deceased	D2 - Correct procedure not known.
Colleague	D2 - Correct procedure not known.

Case No 102

Part of a floor in a building used as a potato store had collapsed. The farmer had thought the remainder safe and so he and a worker were repairing the collapsed portion by filling under it with hardcore. More of the floor collapsed and the deceased was buried under the potatoes from 1-ton boxes stacked 3 high.

Coding:

Deceased	B6 - Correct test not chosen and correctly executed.
Employer	C6 - Need for action not recognised.

Case No 103

Whilst felling a windblown tree the deceased first snedded it and then stood on the downhill side with the 4m x 3m root plate beside him. As he cut through the trunk his chainsaw became trapped so he returned to the saw mill for a second saw. One cut through the trunk it slid away and the root plate fell, crushing him.

Coding:

Deceased	D2 - Correct procedure not known.
Employer	C6 - Need for action not recognised.

Case No 104

Whilst driving a poorly maintained uncabbed tractor along an isolated road, a mechanical fault developed causing the front wheels to breakaway from the tractor. The rest of the tractor overturned sideways trapping the deceased a 42 year old farmer.

Coding:

Deceased	C5 - Responsibility for testing not accepted.

Case No 105

A 77 year old fit, active farm foreman was knocked down by a reversing trailer loaded with sugar beet. Rearward visibility was severely limited. The deceased died six days later of a pulmonary embolism, following thrombosis and a broken leg.

Coding:

Deceased	E1 - Response not correctly executed.
Employer	C3 - Responsibility for implementing procedure not accepted.
Colleague	E3 - Procedure not correctly executed.

Case No 107

The deceased a 26 year old director of a farming company was standing at the edge of a loft floor when he fell backwards approximately 16½ft through a 15 inch gap between the end of a guard rail and an elevator. The deceased suffered from Myotonia Dystrophica which would have slowed his reflexes possibly preventing him from saving himself.

Coding:

Deceased	E3 - Procedure not correctly executed.

Case No 108

A 64 year old farmer reached up from a damaged step ladder to paint a fuel tank. He fell onto oil drums rupturing his spleen and dying 13 days later from his injuries.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 109

A 62 year old farm worker was carrying out construction work in a piggery when the ladder he was on slipped on wet ground and he fell approximately 5ft. He died 7 days later of a pulmonary embolism as a result of a broken femur.

Coding:

Deceased	D3 - Correct procedure not chosen.
Employer	D3 - Correct procedure not chosen.

Case No 110

Whilst a passenger in a tractor mounted transport box travelling between farms the tractor was involved in a road traffic accident and the deceased was thrown out sustaining a fractured skull.

Coding:

Deceased	E3 - Procedure not correctly executed.
Employer	C6 - Need for action not recognised.
Colleague	E3 - Procedure not correctly executed.

Case No 111

Whilst tending sheep the deceased took a loaded shotgun with him to practice for a forthcoming shooting holiday. The gun was carried vertically on the nearside footplate with barrels pointing upwards. It discharged into the deceased's head whilst the tractor was stationary. The deceased had suffered from depression and was taking antidepressants but was thought to have recovered.

Coding:

Deceased	D2 - Correct procedure not known.

Case No 112

Whilst riding on a ledge at the rear of an open tractor safety cab, the deceased moved on to the linkage or drawbar of a towed manure spreader. He appears to have lost his balance and been dragged between the tractor rear wheel and the mudguard resulting in rib fractures and a punctured lung.

Coding:

Deceased	D3 - Correct procedure not chosen.
Employer	E3 - Procedure not correctly executed.

Case No 113

The 7 year old son of a farmer was assisting his father by shovelling grain into an unguarded augur when his scarf became wound round the augur and he was strangled.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Parent	D3 - Correct procedure not chosen.
Equipment owner	D3 - Correct procedure not chosen.

Case No 114

Whilst taking a walk in the country a 74 year old man walked along a path across a field in which there was 16, 9-15 month old Friesian cross bulls. Sometime later his body was found having multiple injuries. The injuries had apparently been sustained when he was attacked by the bulls.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Owner of animals	E7 - Plan/procedure not correctly executed.

Case No 115

A 70 year old general farm worker was standing on a trailer stacking bales dropped to him by his employer. A bale fell awkwardly bouncing up and hitting the deceased in the chest causing him to step backwards. He tripped over the trailer side and fell breaking his neck and dying of complications six days later.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Employer	C3 - Responsibility for implementing procedure not accepted.

Case No 117

Whilst digging blackcurrant bushes this 51 year old general farm worker cut his foot without realising what he had done. He suffered from diabetes causing peripheral neuropathy resulting in loss of sensation to his feet. The deceased died of tetanus six days later.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.

Case No 118

Whilst harvesting lettuce by hand inside a glasshouse the deceased grasped a stanchion to assist him to stand and was electrocuted. A CO_2 burner suspended from the glasshouse by chains was probably faulty. It was installed using a twin core extension lead probably supplied by the deceased. The absence of an earth wire caused a fault current to track through the glasshouse structure which was isolated from the ground by concrete plinths. (The installer had a similarly looking three core extension lead, so failed to check the one owned by the deceased).

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Installer	C3 - Responsibility for implementing procedure not accepted.

Case No 119

Whilst scraping slurry in a cubicle house the deceased forgot to lower the fold-down roll bar. Passing through a low doorway the top of the roll bar dislodged a length of concrete guttering which fell crushing the deceased. The doorway predated safety cab legislation.

Coding:

Deceased	E3 - Procedure not correctly executed.
Deceased	C4 - Need to test for danger not known/recognised.
Machine owner	D3 - Correct procedure not chosen.

Case No 120

Whilst roofing a shed on a farm in which he was a partner the deceased and others were carrying a big six sheet, when he slipped backwards on to some flat asbestos sheet capping which was thinner than the big six sheets on which he had been walking. He fell 6 m fracturing his skull and dying 5 days later. The supplier of the sheets was on site and advising but the farmer retained control of operations.

Coding:

Deceased	D2 - Correct procedure not known.
Owner of building	D2 - Correct procedure not known.
Installer	C3 - Responsibility for implementing procedure not accepted.

Case No 121

While spreading manure the deceased and his brother learned that some of their cattle had escaped on to a public road. Whilst travelling on a tractor that had been used for manure spreading, the deceased slipped from the nearside footplate and was run over.

Coding:

Deceased	D2 - Correct procedure not known.
Colleague (Self-emp)	D2 - Correct procedure not known.

Case No 122

Whilst sweeping moss and debris from an asbestos cement roof the deceased stepped through a perspex skylight and fell 3.5 m. Crawling boards were available and he had been reminded by a colleague immediately before the accident, of the need to use them. He died of a pulmonary embolism arising from head and chest injuries.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Employer	E3 - Procedure not correctly executed.
Colleague	E3 - Procedure not correctly executed.

Case No 123

Whilst small scrub and trees were being moved to a fire, one slipped from the forks of a fore-end loader striking the deceased on the head. He had previously moved away from the danger zone but not far enough. A safety helmet may have saved him.

Coding:

Deceased	E7 - Plan/procedure not correctly executed.
Employer	C5 - Responsibility for testing not accepted.
Employee	E7 - Plan/procedure not correctly executed.

Case No 124

The deceased worked as one of a two-man gang cutting up trees which his colleague had felled. His colleague had felled a 100ft spruce tree not realising the deceased was only 85ft away. The deceased was wearing a safety helmet but died with multiple injuries to the body.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	C6 - Need for action not recognised.
Employee	E7 - Plan/procedure not correctly executed.

Case No 125

The deceased a 50 year old general farm worker apparently went to collect hay from a stack which collapsed burying and enveloping her in polythene. She was asphyxiated.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	C4 - Need to test for danger not known/recognised.

Case No 126

The deceased was cutting up a smouldering bough which had fallen from an ash tree when the rest of the tree fell upon him. Subsequent examination revealed that the tree trunk had been hollowed out and severely weakened by the fire. There was no external evidence to suggest that it was in a dangerous condition. The prevailing wind is thought to have brought the tree down.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	C4 - Need to test for danger not known/recognised.

Case No 127

The deceased aged 6 was playing with his two brothers aged 7 and 4 in his farmyard home when a tractor and loading manure spreader being driven by an aunt arrived. The oldest boy opened the gate and all three boys stood back to wait for the tractor to go through. As it pulled off the deceased suddenly darted forward to retrieve his water pistol from the ground immediately in front of the spreader wheel and was run over.

Coding:

Deceased	E1 - Response not correctly executed.
Parent	E3 - Procedure not correctly executed.
Employee	D2 - Correct procedure not known.

Case No 129

The 3½ year old daughter of a farmer was playing in the garden of the farmhouse when she went missing. She was found a short time later drowned in the farm's slurry store having wandered a considerable distance through the farmyard and buildings.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Parent	E7 - Plan/procedure not correctly executed.

Case No 130

In company with his grandson an 80 year old retired farmer was hand seeding a small strip across a field in which they were grazing a Friesian bull and 12 heifers. His grandson left him and some time later he was found dead having been attacked by the bull.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Self-employed	D2 - Correct procedure not known.
Animal owner	D2 - Correct procedure not known.

Case No 131

A 14 year old boy was assisting with the laying of drainage tiles. He was run over by the slow moving excavator which was reversing along the trench side. How he came to be run over was unknown. He may have tripped adjacent to the track. He died of the inhalation of vomit following crush injuries to the back, spine, pelvis, ribs and legs which injuries he could not have survived.

Coding:

Deceased	E3 - Procedure not correctly executed.
Employee	E3 - Procedure not correctly executed.
Machine owner	C4 - Need to test for danger not known/recognised.
Parent	C3 - Responsibility for implementing procedure not accepted.

Case No 132

The deceased a 55 year old general farm worker climbed to the top of a straw stack and promptly fell approximately 3.5 m for no apparent reason. The deceased had a pre-existing heart condition which may have caused dizziness or a heart attack but his injuries were so severe that this could not be determined.

Coding:

Deceased	E3 - Procedure not correctly executed.
Employer	C3 - Responsibility for implementing procedure not accepted.

Case No 133

A 67 year old farmer working alone tried to push-start and then mount a moving tractor. He fell and was trapped beneath the rear wheel. His body was found two days later.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Deceased	D3 - Correct procedure not chosen.

Case No 134

While stirring the slurry in a large above ground store the deceased tried to descend an aluminium ladder which was unsecured and rested against the curved rim of the slurry store. The ladder slipped and the deceased fell fracturing his skull.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 135

A 68 year old man entered a field looking for the owner to enquire about the purchase of some firewood. The deceased was apparently unaware of the presence of a ram running with ewes and lambs and had with him a black poodle. The deceased was attacked by the ram who repeatedly pounded his chest for about 20 minutes. He died 53 days later from cardiac respiratory failure resulting from shock. The ram was apparently protecting the ewes and lambs from the strange dog.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Owner of land	E7 - Plan/procedure not correctly executed.

Case No 136

Whilst attempting to catch and treat a scouring calf the deceased slipped fracturing her right femur. She died 15 days later of a pulmonary embolism resulting from a fracture. Footwear may have been smooth soled.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.

Case No 137

A 19 year old healthy farm worker with 7 months experience of farm work was gassed in the blind end of a tower silo chute during pre-entry ventilation. Instruction had been given but the deceased was probably caught in the CO_2 airflow. Instruction not extensive enough.

Coding:

Deceased	D2 - Correct procedure not known.
Employer	C6 - Need for action not recognised.
Designer	D7 - Correct plan/procedure not chosen.
Colleague	D2 - Correct procedure not known.

Case No 138

The deceased a 10 year old boy was standing on the nearside footplate of a tractor towing a rotovator and driven by his father. He slipped and fell from the tractor and sustained multiple injuries when the rotovator passed over.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Parent	C3 - Responsibility for implementing procedure not accepted.
Machine owner	C3 - Responsibility for implementing procedure not accepted.

Case No 139

Whilst felling trees across a slope in a gusty wind a tree was felled which was caught by the wind, and fell uphill of the intended line of fall. It struck the deceased who was snedding a tree which he had felled earlier. Death was due to multiple internal injuries to the chest and abdomen.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Colleague	C3 - Responsibility for implementing procedure not accepted.

Case No 140

Whilst driving a tractor with a rear mounted fork lift on which there were six bales which obstructed his rearwards view, the deceased turned right off the public highway. An overtaking articulated lorry struck the tractor a glancing blow causing it to overturn and break up. The deceased died of multiple injuries.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Employer	C3 - Responsibility for implementing procedure not accepted.

Case No 141

A 13 year old boy visited a field where haymaking was in progress in order to offer help to the (part-time) farmer. Having talked to the farmer the deceased was standing too close to a hay tedder when the power take-off was engaged. He passed through the tedder.

Coding:

Deceased	D2 - Correct procedure not known.
Machine owner	E3 - Procedure not correctly executed.

Case No 142

A tractor and loaded grain trailer were being driven slowly and apparently sensibly by a 15 year old farmer's son, down a farm track. The deceased a 9 year old boy had been present at the site with his bike and had apparently tried to overtake the tractor and trailer. He fell beneath the trailer wheel.

Coding:

Deceased	A1 - Correct response not in programme.
Machine owner	C4 - Need to test for danger not known/recognised.
Colleague (child)	C6 - Need for action not recognised.

Case No 143

Whilst driving a County crawler tractor (based upon a Fordson Major and cab) towing a roller and harrows in a steep field, it appears that the deceased tried to bump start the tractor causing it to go out of control and overturn several times into a wood.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 144

Whilst assisting his 60 year old son in the felling and splitting into fence posts of ash trees the deceased was struck by a falling tree causing severe injuries to his foot. He subsequently died of a stroke. The deceased was an 84 year old farm manager who had worked for the same employer for 72 years. His son had little idea about the correct techniques of tree felling.

Coding:

Deceased	D2 - Correct procedure not known.
Colleague (employed)	D2 - Correct procedure not known.
Employer	D2 - Correct procedure not known.

Case No 145

Whilst preparing an unguarded Massey Harris 701 baler for work, the deceased attempted to pick up a dropped petrol cap and became caught in the mechanism. His arm was amputated and he died of shock.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 146

Whilst at work the deceased a 45 year old farm worker stepped on something which penetrated his foot. Not having been immunised against tetanus he died.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	C4 - Need to test for danger not known/recognised.

Case No 147

Whilst visiting an orchard adjacent to the house in which he lived as a semi-retired cook the deceased a frail 72 year old man was butted by a Suffolk cross Kent ram and died of shock from internal injuries.

Coding:

Deceased	E1 - Response not correctly executed.
Employer	C3 - Responsibility for implementing procedure not accepted.

Case No 149

The deceased a 46 year old employee entered a poultry meal bin alone to clear a blockage and was found asphyxiated under the meal.

Coding:

Deceased	D2 - Correct procedure not known.
Employer	C6 - Need for action not recognised.

Case No 150

The deceased a 36 year old self-employed farmer was electrocuted when he touched a live bale elevator whilst also touching the steel framework of a barn into which hay bales were being stacked. The elevator had been borrowed from a neighbour and was connected to the electricity supply through several extension cables with a discontinuous earth. The fault in the switch was thought to have made the elevator live.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Owner of machine	C4 - Need to test for danger not known/recognised.
Colleague (self-empl'd)	C4 - Need to test for danger not known/recognised.

Case No 151

Approximately 5 weeks after starting work on a farm to gain experience before going to agricultural college the deceased an 18 year old was instructed to clean a tractor mounted cement mixer that he had been using. He operated a control from the rear of the tractor and became trapped between the mixer and the cab. The deceased had been instructed how to operate the controls from within the cab but not specifically told not to operate them from the rear.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	E3 - Procedure not correctly executed.
Employee	E3 - Procedure not correctly executed.

Case No 152

A 59 year old farmer was attempting to treat a severe rat infestation on his farm rather than pay the council for treatment. He contracted Weil's disease. Apparently he was unaware of the hazard and failed to take sensible hygiene precautions.

Coding:

Deceased	D2 - Correct procedure not known.

Case No 153

A 43 year old farmer was renovating a trailer which had been unused for 6-7 years. The hydraulic tipping ram was sticking so the deceased went beneath the unpropped trailer and removed an hydraulic pipe thus permitting the trailer body to descend trapping him by the neck.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 154

A 69 year old farmer was driving a tractor fitted with a roll bar and mounted hay tedder across a 1:10 slope. The deceased tried to execute a U-turn at speed, the_tractor rolled and then careered away down the field. The deceased was thrown clear but died of shock from crush injuries to the abdomen.

Coding:

Deceased	D2 - Correct procedure not known.

Case No 155

The 10 year old son of a farmer was assisting his father using an augur to move grain from a bin into a lorry. The deceased was drawn into the grain and drowned.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Owner of equipment	C3 - Responsibility for implementing procedure not accepted.
Parent	C3 - Responsibility for implementing procedure not accepted.

Case No 156

The deceased was standing in a tall apple tree using a 5 metre metal pole to dislodge apples which were being collected by his wife. The pole touched overhead power lines and he was electrocuted.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Non-employee	C4 - Need to test for danger not known/recognised.

Case No 157

Whilst sweeping dust from the walls of a brick built grain bin from which grain was being removed the deceased was drawn into the grain and asphyxiated. The deceased was a 16 year old youth who had only been working on the farm for a couple of months.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	C3 - Responsibility for implementing procedure not accepted.
Colleague (employee)	D3 - Correct procedure not chosen.

Case No 158

A 70 year old retired farm manager living on his son in laws farm was assisting with hay making. Whilst driving a Fordson Super Dexter tractor not fitted with roll over protection, he was engaged in turning hay when the tractor ran away. The deceased jumped clear before the tractor overturned but sustained chest injuries on landing. Complications set in hampering his recover and he died of a heart attack following surgery.

Coding:

Deceased	E1 - Response not correctly executed.
Machine owner	C3 - Responsibility for implementing procedure not accepted.

Case No 159

A 69 year old retired farm worker was assisting his son a self-employed forestry contractor in taking down a hung up tree. Having attached a chain to the butt the deceased moved away from the intended direction of fall but the tree twisted falling on him. He was not wearing head protection but such protection may not have saved him.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	D2 - Correct procedure not known.
Colleague (self-empl'd)	C3 - Responsibility for implementing procedure not accepted.

Case No 160

A 49 year old self-employed farmer was working with his brother on an asbestos cement roof repairing windows. He was walking along the asbestos cement sheets and stepped onto a perspex roof light which gave way causing him to fall approximately 3 m. He sustained head injuries from which he died the next day.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Building owner	C3 - Responsibility for implementing procedure not accepted.

Case No 161

The deceased was walking backwards attempting to turn a difficult cow into a stall. He fell backwards for no apparent reason (a pre-existing medical condition may have caused dizziness) striking his head on a concrete floor. The deceased was a 65 year old stockman.

Coding:

Deceased	A1 - Correct response not in programme.
Employer	C4 - Need to test for danger not known/recognised.
Colleague (employee)	C4 - Need to test for danger not known/recognised.

Case No 162

A 20 year old skilled and experienced general farm worker was driving a Peter Standen sugar beet harvester when the cyclone became blocked. In attempting to clear the blockage he crawled beneath the machine which was still running. His clothing became caught on a shaft driven from the power take-off via a belt drive and he was asphyxiated.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Machine owner	C3 - Responsibility for implementing procedure not accepted.

Case No 163

A 22 year old casual tractor driver was two weeks into his third season for a field bean co-operative. Whilst driving a tractor with a high lift trailer he attempted to tip beans into boxes on a stationary articulated lorry trailer. The high lift trailer contacted the 11 kV overhead cables and he was electrocuted. The trailer had been delivered after dark and the accident had occurred early next morning in a heavy mist.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	E3 - Procedure not correctly executed.
Machine owner	C4 - Need to test for danger not known/recognised.
Colleague (not empl'd)	C4 - Need to test for danger not known/recognised.

Case No 164

A 78 year old self-employed smallholder fell (reason unknown) onto a scythe cutting her thigh. She died twelve days later, it is thought of tetanus but that could not be proved conclusively

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 167

Deceased a 67 year old self-employed farmer was loading cattle into a lorry assisted by his son and the lorry driver. The son left to deal with other escaping cattle at which time those in the lorry pushed against the partially closed lorry gates. One gate broke along the line of a previous poor quality repair and deceased was knocked against a brick wall sustaining head injuries which proved fatal.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Lorry owner	E1 - Response not correctly executed.
Lorry owner	E3 - Procedure not correctly executed.
Colleague	C4 - Need to test for danger not known/recognised.

Case No 168

The deceased a 59 year old self-employed farmer fell approximately 9ft when a poorly placed ladder (in good condition) slipped out. The ladder had been placed at approximately 45°. The deceased died almost a weak later from peritonitis.

Coding:

Deceased	D2 - Correct procedure not known.

Case No 169

The deceased a 60 year old self-employed farmer with an arthritic leg dismounted from his tractor and went to the rear of the potato harvester it was towing, apparently to check performance. His wife was on the picking platform and a neighbour was driving the potato trailer. The deceased became caught on the drive to a trash elevator which had been removed but the drive belt left connected. It is thought that he may have stumbled due to his arthritis.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Deceased	C4 - Need to test for danger not known/recognised.
Colleague (self-empl'd)	D2 - Correct procedure not known.
Colleague (self-empl'd)	C3 - Responsibility for implementing procedure not accepted.

Case No 170

The 8 year old schoolboy son of a farmer was assisting his two older brothers in mixing concrete using a power take-off driven mixer. The power take-off shaft was partially unguarded and deceased's clothing became entangled.

Coding

Deceased	D2 - Correct procedure not known.
Owner of mixer	C3 - Responsibility for implementing procedure not accepted.
Parent	D2 - Correct procedure not known.
Colleague (child)	D2 - Correct procedure not known.

Case No 171

The deceased a fit healthy 64 year old general farm worker was clearing out roof valley gutters on a windy day when he slipped on or fell against a fragile roof light. He fell about 8ft landing on a concrete floor (possibly on a curved edge) and sustained fatal head injuries. Deteriorating weather conditions may have been significant.

Coding:

Deceased	D3 - Correct procedure not chosen.
Owner of building	C4 - Need to test for danger not known/recognised.
Employer	C7 - Responsibility for action not accepted/allocated.

Case No 172

The deceased was a 30 year old self-employed farmer. He was standing in front of the front offside wheel of a recently purchased Massey Ferguson 780 combine, apparently attempting to tighten a leaking nut on a fuel line. He appears to have pulled the starter motor linkage for reasons unknown causing the combine to move forward off the edge of a concrete apron. He was trapped beneath the wheel. The deceased was inexperienced with combines, the combine brakes were inoperative and it had been left in gear.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Deceased	D2 - Correct procedure not known.

Case No 173

The deceased was a 60 year old lorry driver delivering seed grain to a farm. A 12ft steel gate clad with aluminium had been opened and propped to permit the entrance of the lorry. The prop slipped and the gate caught by the wind swung through 120° crushing the deceased against the wheel of the lorry. He died of a ruptured aorta.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Occupier of land	D2 - Correct procedure not known.
Colleague (employee)	C4 - Need to test for danger not known/recognised.

Case No 174

A 26 year old self-employed farmer was driving a cabbed tractor turning hay. The offside cab door had been removed. He drove too close to the top of a steep bank causing the tractor to overturn on to its nearside. Deceased appears to have tried to jump or to have been ejected through the open offside doorway and was trapped by the chest under the lintel. Coroner referred to deceased as having 'worked a long day possibly under trying conditions'.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 175

A 20 year old farmer's son was working on a neighbouring farm ploughing steep land. The deceased drove a four wheel drive tractor too close to the top of a steep bank causing it to overturn through 720°. The deceased managed to drive the tractor to seek assistance but died soon after. It is thought that he stayed in the cab yet he suffered crush injuries to the chest. The roof came off in the first overturn.

Coding:

Deceased	E3 - Procedure not correctly executed.
Employer	E7 - Plan/procedure not correctly executed.

Case No 176

The deceased was a large 52 year old general farm worker. In dismounting from a Massey Ferguson 35 tractor he appears to have stood on the clutch pedal (footplate obstructive) then caught the gear lever with his other leg causing the tractor to jerk forward when he dismounted. The tractor ran over his abdomen. He died six days later with pulmonary embolism. Evidence suggests that the handbrake was not applied.

Coding:

Deceased	E3 - Procedure not correctly executed.
Employer	C4 - Need to test for danger not known/recognised.

Case No 177

A 2 year old girl was riding on the offside footplate of an International Harvester 434 tractor fitted with a weather cab being driven slowly across a cultivated field by her father. The ill-fitting door suddenly sprang open and she fell out sustaining head injuries from which she died.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Machine owner	C3 - Responsibility for implementing procedure not accepted.
Parent	C3 - Responsibility for implementing procedure not accepted.

Case No 178

The end of a mushroom shed (24ft x 9ft) had been removed and left propped against stanchions between two other sheds. Sometime later it blew down onto a 48 year old female supervisor who was passing, causing crush injuries to the chest.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	E7 - Plan/procedure not correctly executed.
Employee	D2 - Correct procedure not known.

Case No 179

Deceased, a 23 year old inexperienced mechanic turned crawler tractor driver was returning to the farmstead driving a loader shovel. In order to avoid a sharp turn onto a bridge, he chose a straight route down a moderate hill. The transmission overrode the engine which stalled. The loader shovel ran down the hill out of control, hit the side of the bridge, slid then toppled into the stream, trapping the deceased beneath one track which had become detached during the overturn.

Coding:

Deceased	D2 - Correct procedure not known.
Employer	C4 - Need to test for danger not known/recognised.

Case No 180

Due to a fault in the starter circuit of his tractor, the deceased a 51 year old tractor driver, was attempting to start it using a piece of wire connected between the coil and the starter motor. Whilst standing on the ground, he started the tractor, which as it was in a low gear, ran forward damaging a wall. Still standing on the ground, the deceased attempted to select neutral but inadvertently selected reverse, and was run over by the tractor as it moved backwards.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	D7 - Correct plan/procedure not chosen.
Other person	D7 - Correct plan/procedure not chosen.
Employer	C6 - Need for action not recognised.

Case No 181

Whilst dismounting from a tractor holding a loaded shotgun, the gun discharged, killing the deceased, a 32 year old self-employed farmer. Suicide was suspected because of the precision of the wound, but the pathologist confirmed that the absence of powder on the hands indicated that the deceased hadn't pulled the trigger.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 182

Whilst assisting his father (employer) in the removal of timber from a building about to be demolished, an unsupported gable end fell onto the deceased, an 18 year old. Windy conditions are thought to have caused the gable end to fall. The Inspector felt that protective headgear may have saved the deceased.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C4 - Need to test for danger not known/recognised.
Employer	C4 - Need to test for danger not known/recognised.

Case No 183

Whilst attempting to disengage the power take-off drive to a blocked mill and mixer by reaching in from the rear of the tractor, the deceased's clothing became drawn under the tractor's power take-off shield. The machinery complied with the Power take-off Regulations. Deceased a 21 year old farmer was released immediately but died of shock as a result of the traumatic amputation of his left arm. The machine blocked regularly.

Coding:

Deceased	D3 - Correct procedure not chosen.
Colleague (self-empl'd)	D3 - Correct procedure not chosen.
HSE	C3 - Responsibility for implementing procedure not accepted.

Case No 184

Whilst felling a hedgerow sycamore tree (9 metres high by 400 mm diameter) it twisted unexpectedly and fell onto the deceased, a 28 year old self-employed farmer. Deceased was knocked unconscious and choked. Safety helmet not worn.

Coding:

Deceased	D2 - Correct procedure not known.
Colleague (self-empl'd)	D2 - Correct procedure not known.

Case No 185

A 40 year old self-employed herdsman was killed whilst opening a gate across a quiet country lane early in the morning. Dry cows were about to be moved out onto the road when the gate was hit by a motor cycle travelling in excess of 80 mph. The motor cyclist (a 17 year old farm worker, late for work) was also killed, his death being recorded as a road traffic accident.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	E3 - Procedure not correctly executed.
Colleague (employed)	E3 - Procedure not correctly executed.

Case No 186

Whilst working with sheep a 79 year old Shetland Islands crofter was butted in the stomach by a ram. He died 2 days later of peritonitis.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.

Case No 187

Deceased a 54 year old farmer had hired a digger and driver to carry out some drainage work. Whilst laying tiles in an 2.5 metre deep trench, it collapsed trapping deceased who was asphyxiated.

Coding:

Deceased	D2 - Correct procedure not known.
Colleague (self-empl'd)	D2 - Correct procedure not known.
Colleague (employed)	D3 - Correct procedure not chosen.
Supplier (service)	C4 - Need to test for danger not known/recognised.

Case No 188

Deceased a 15 year old schoolboy was assisting on his father's farm when he connected the plug on a 1,000 watt inspection lamp into a wall socket. The socket was defective in that the earth wire was live at 240 volts. Deceased was standing in water and received a fatal shock.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Owner (equipment)	C6 - Need for action not recognised.
Parent	C6 - Need for action not recognised.

Case No 189

Deceased a 46 year old farmer was using a McConnell Power Arm S12C digger mounted on a tractor fitted with a safety cab. In attempting to push the tractor forward using the digger bucket, he became trapped between the control console and the rear top cab cross member. Deceased had received 2 warnings from the manufacturer, 2 warnings from Inspectors, and had previously been trapped and severely bruised.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 190

Deceased a 47 year old farmer was suffering from bouts of giddiness brought on by influenza. He knelt on a wall and reached down into a grain bin to sample barley which had overheated and was being transferred to another bin. He fell head first into the moving grain and suffocated.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.

Case No 191

Deceased (aged 41) had set up in business a month before the accident, as a self-employed tree feller. He attempted to fell a 1 metre diameter, 16 metre high, dead elm tree, using a chain saw with too small a guidebar. The tree fell in the opposite direction to the intended line of fall, then rolled onto the deceased who had tripped and fallen whilst trying to escape.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	D2 - Correct procedure not known.
Colleague (employee)	D2 - Correct procedure not known.

Case No 192

Deceased was a 56 year old director of a pea vining co-operative. He parked a borrowed forklift behind a lorry, having previously instructed the lorry driver to reverse his vehicle. Whilst altering the fork width, the lorry was reversed crushing the deceased. Snow and ice made driving conditions difficult.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	D7 - Correct plan/procedure not chosen.
Colleague (employee)	C7 - Responsibility for action not accepted/allocated.

Case No 193

The 39 year old deceased was employed as a second boatman on a boat used to ferry farming materials from one Scottish Island to another. Whilst attempting to retrieve a book from the bilges he became entangled on the propeller shaft drive and was asphyxiated.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Employer	C5 - Responsibility for testing not accepted.
Colleague (employee)	C7 - Responsibility for action not accepted/allocated.

Case No 194

The deceased was a 40 year old experienced general farm worker who was moving irrigation pipes. He swung a pipe vertically through 90° in order to reverse the couplings. The pipe contacted an 11 kV overhead power line. Deceased was experienced, well aware of the hazard (he had previously warned others whom he was supervising), and had been instructed in the system of work to be adopted, less than 24 hours previously.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Employer	E7 - Plan/procedure not correctly executed.

Case No 195

The 2 year old daughter of a farmer went missing during manure spreading operations. She appears to have been buried under a fall of manure from a stack, and was asphyxiated. Her body was found loaded into a spreader.

Coding:

Deceased	C4 - Need to test for danger not known/recognised
Machine owner	D2 - Correct procedure not known.
Parent	D2 - Correct procedure not known.

Case No 196

Deceased a 30 year old farmer was driving a poorly maintained tractor with rear mounted fork lift. Mounting points were corroded and some were missing. The lower mounting points failed causing the forklift mast and carriage to pivot forward and fall onto the deceased in the driving position.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 197

Whilst feeding cows in a byre the deceased a 64 year old self-employed farmer carrying a bucket of turnips attempted to squeeze between two tethered cows. He slipped on some fresh manure on the concrete floor, fell and was trampled on by the startled cows. He died two days later.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 198

The deceased a 24 year old farmer's son was felling poplar trees. He had about 6 years experience of using chainsaws but was using an incorrect technique (no sink cuts). The tree being felled, split, pivoted upwards on the uncut portion apparently knocking the deceased's safety helmet off. The tree then fell onto the deceased causing fatal head injuries.

Coding:

Deceased	D2 - Correct procedure not known.
Colleague	C4 - Need to test for danger not known/recognised.

Case No 199

A 53 year old full-time forestry worker was clearing a windblown chestnut tree. He was cutting up a trunk which moved suddenly causing the deceased to fall against the end of a short dead branch protruding from an adjacent trunk. The branch entered below and behind his right ear causing brain damage. Deceased died 30 days later of pneumonia.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	C4 - Need to test for danger not known/recognised.

Case No 201

Whilst apparently checking the operation of a side delivery feed wagon, the deceased a 23 year old self-employed temporary worker scaled a wall to get a better view. As he swung his leg over the wall his foot was caught in the discharge mechanism and he was pulled through the machine, his body being ejected into the feed manger.

Coding:

Deceased	D2 - Correct procedure not known.
Owner of machine	C4 - Need to test for danger not known/recognised.
Colleague (employed)	C4 - Need to test for danger not known/recognised.

Case No 202

A 60 year old farm employee due to be made redundant the next day was set to work to repair the drawbar on a static caravan. The caravan slipped from a bottle jack onto the deceased's chest causing him to be asphyxiated. The deceased had 29 years experience of farm repair work. He may have been preoccupied with his impending redundancy

Coding:

Deceased	C3 - Responsibility for implementing correct procedure not accepted.
Employer	C4 - Need to test for danger not known/recognised.

Case No 203

A 2 year old girl and her 4 year old brother were left inside a tractor cab whilst their parents attended a calving cow. The girl tried to dismount and fell from the step whereupon the tractor ran forward over her. The handbrake had not been fully applied on a slight slope.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Owner of machine	D7 - Correct plan/procedure not chosen.
Parent	D7 - Correct plan/procedure not chosen.

Case No 204

The deceased was employed to carry out estate maintenance work and was pointing a chimney from an inadequately secured ladder laid on the roof tiles. The ladder slipped and the deceased fell approximately 7m fracturing his neck. An adequate roof ladder was available to this highly experienced worker but was not used. The deceased had returned to work the day before after a period of illness including dizziness. He was thought to have fully recovered.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Employer	D7 - Correct plan/procedure not chosen.

Case No 205

Whilst driving an old four wheel drive uncabbed tractor the deceased took a short cut down a steep part of a field. In attempting to turn right apparently at excessive speed the tractor overturned through 180^{o} onto its nearside. The deceased suffered multiple crush injuries.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 206

A 15 year old schoolboy was assisting voluntarily on a farm and was sent to check the progress of grain being removed from a silo. He appears to have fallen in breaking his neck in the fall. Being unable to save himself he was drawn into the grain and drowned.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Equipment owner	C4 - Need to test for danger not known/recognised.

Case No 207

A 45 year old self-employed builder was erecting a mushroom shed on his own land. Whilst attempting to cover the tubular framework with sheeting he was standing in the bucket of an excavator. Whilst dismounting he slipped and fell 12ft and died of a fractured skull.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Colleague	C3 - Responsibility for implementing procedure not accepted.

Case No 208

A fire in an unattended lean-to barn containing large hay and straw bales stacked on their ends was started by two 15 year old boys playing with matches. One of the boys perished. The fire was fuelled by natural chimneys within the straw which caused it to spread particularly quickly. Occupiers aware of trespassing.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Occupier	C7 - Responsibility for action not accepted/allocated

Case No 210

Whilst moving irrigation pipes the deceased a 41 year old market gardener apparently lifted one pipe vertically beneath an 11kV power line and was electrocuted.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.

Case No 211

A 42 year old self-employed farmer was attempting to extricate a tractor from the edge of a silage clamp which had partially collapsed. The tractor overturned through 270^0 into a slurry pit. The accident happened in pitch dark just after midnight. The deceased's blood contained 218 mg of alcohol per 100 ml. He was assisted in the operation of extricating the tractor by his 17 year old son.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Child	C5 - Responsibility for testing not accepted.

Case No 212

The deceased a 62 year old casual employee was working on a potato harvester when she appears to have been taken ill. She moved to the edge of the platform and then fell off and was run over by a harvester wheel.

Coding:

Deceased	E1 - Response not correctly executed.
Employer	C4 - Need to test for danger not known/recognised.

Case No 213

A 33 year old police sergeant was shooting vermin on his father's farm at night with a lamp attached to the barrel of .22 rifle. Deceased appears to have tripped banged the rifle butt on the ground, causing it to discharge through his head. The rifle was due to be returned by the deceased to his supplier for rectification of a fault. Accidental discharge situation reproduced by forensic scientists.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	D7 - Correct plan/procedure not chosen.

Case No 214

The 51 year old deceased was employed as a fuel delivery driver. In attempting to connect a hose the deceased climbed about 1.6 metres up an unsecured aluminium ladder propped against a greasy fuel tank. The ladder slipped sideways and the deceased sustained head injuries from which he died 2 hours later. The deceased had received instruction in ladder safety and had the right to refuse to make the delivery, but accepted the dangerous situation.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Employer	D3 - Correct procedure not chosen.
Occupier	C3 - Responsibility for implementing procedure not accepted.

Case No 215

The 11 year old son of a part-time farmer entered a dark shed and approached a tractor from the rear. He became caught on the revolving power take-off stub of the Nuffield tractor which was being repaired by his father and grandfather.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Machine owner	D2 - Correct procedure not known.
Parent	D2 - Correct procedure not known.

Case No 216

An 86 year old self-employed farmer was on the top of a straw stack attempting to extract a hay bale. He apparently stood on an insecure straw bale and fell about 3m onto a concrete floor feed passage, fracturing his skull.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Colleague (self-empl'd)	C3 - Responsibility for implementing procedure not accepted.

Case No 217

The deceased was a 38 year old self-employed forestry contractor driving a four wheel drive tractor which was not fitted with roll over protection. He was extracting timber down a slope. In mounting a parked tractor the deceased knocked the four wheel drive engagement lever. This caused the four wheel drive to disengage, thus letting off the brakes on the rear wheels. The tractor ran away and the deceased was catapulted off and run over.

Coding:

Deceased	A1 - Correct response not in programme.
Deceased	C4 - Need to test for danger not known/recognised.
Machine owner	C3 - Responsibility for implementing procedure not accepted.

Case No 218

A 27 year old farmer was supervising a bull serving a cow who was going off heat and would not stand for the bull. The bull became aggressive and the deceased died of a rupture liver. Because of poor handling facilities the bull was in fact due to leave the farm to be replaced by artificial insemination.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	E3 - Procedure not correctly executed.
Colleague (employed)	E1 - Response not correctly executed.

Case No 219

A 57 year old general farm worker went to drive a bull and cow back to a farmhouse. He was found dead five minutes later. There were no signs of aggression from the bull or cow either before or after the event. His injuries were however consistent with an attack by an animal.

Coding:

Deceased	C6 - Need for action not recognised.
Employer	C4 - Need to test for danger not known/recognised.

Case No 220

A 68 year old self-employed farmer had a leaking water trough. Instead of repairing the ball valve the deceased was in the habit of controlling the water at the Water Board stopcock by means of a "T" bar. The deceased inadvertently screwed the body of the stopcock out of its housing and in attempted to retrieve it slipped head first into a water filled manhole and drowned.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Deceased	D2 - Correct procedure not known.
Installer	C6 - Need for action not recognised.

Case No 221

Deceased a 44 year old self-employed farmer was driving a tractor with a mounted fertiliser spreader across a 24° slope when he turned downhill. The tractor ran away downhill overturning through 540°. The safety cab partially collapsed. A spring in the four wheel drive mechanism was found to be displaced. The tractor was in two rather than four wheel drive.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.

Case No 222

The deceased was a 15 year old boy assisting his aunt in lifting turnips, when his arm became caught on a completely unguarded power take-off shaft.

Coding:

Deceased	D2 - Correct procedure not known.
Machine owner	D2 - Correct procedure not known.
Parent	D2 - Correct procedure not known.

Case No 223

The deceased was a 15 year old boy helping on a farm. He was riding on the drawbar of a tractor driven by one of the partners in the family farming business, despite having recently being told not to ride on it. The driver condoned his action, and the deceased fell from the drawbar and was then run over by the following trailer.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Machine owner	C3 - Responsibility for implementing procedure not accepted.
Parent	C3 - Responsibility for implementing procedure not accepted.

Case No 225

The deceased the 19 year old son of the occupier was killed while taking a shower in a shower block built for use by caravanners on site. An underground cable had become damaged causing electricity to feed onto the earth cable then to the water pipe leading to the shower.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Employer	C4 - Need to test for danger not known/recognised.

Case No 226

The 4 year old son of an itinerant sheep shearer visiting a farm to dock sheep's tails, wandered off and was found drowned in a sheep dip tank. The tank had been supplied without a lid or cover. The rails around it had been removed the day before for use elsewhere, and heavy rain had left standing puddles which broke up the outline of the tank making the edge difficult to see.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Owner	D2 - Correct procedure not known.
Parent	B6 - Correct test not chosen and correctly executed.
Supplier	C3 - Responsibility for implementing procedure not accepted.

Case No 227

The deceased was a 64 year old farm worker engaged in the repair of asbestos roofs following gale damage. He fell 26 feet through an asbestos cement sheet. He was not using crawling boards and had previously been disciplined for this.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Employer	D7 - Correct plan/procedure not chosen.

Case No 228

The deceased was a 31 year old dairymaid who attempted to walk between a wall and the nearside of a manure spreader being reversed down the farmyard by her employer. She slipped and fell head first beneath the spreader wheel. Her employer was looking back over his right shoulder down the offside of the spreader. The suspicion that the employer had been drinking was not substantiated.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Employer	C3 - Responsibility for implementing procedure not accepted.

Case No 229

The deceased a 37 year old self-employed farmer apparently entered the tank of a combined harvester and became caught on the levelling auger. The reason for entering the tank was unknown but the deceased had been seen to do it before, without first disconnecting the drive.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 230

The deceased was the 25 year old nephew of the farmer and was driving a farm-made self-propelled sprayer which was not fitted with a parking brake. He stopped the sprayer on a slight slope went forward to open a gate and was trapped against it when the sprayer ran away. The deceased should have left the sprayer in gear. He probably did not leave it in gear because the slope was only slight.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Machine Owner	C3 - Responsibility for implementing procedure not accepted.

Case No 231

The deceased an 18 year old glass house worker was driving an electric forklift. He drove too near to the edge, of a concrete apron and the forklift overturned through 130° into a ditch. He was crushed between the safety frame and the batteries which were unsecured and located under the driver's seat.

Coding:

Deceased	E3 - Procedure not correctly executed.
Employer	D3 - Correct procedure not chosen.

Case No 232

The deceased was using a rotary manure spreader with a partially unguarded power take-off shaft, and was spreading manure whilst stationery, the manure being thrown into an open manure store. He appears to have been standing adjacent to the shaft when his clothes became entangled. He may have been attempting to climb into the rear of the tractor to reach the controls.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 233

The deceased was 20 months old and was playing in the farmyard supervised by her father who was preparing to shear sheep. The father left the area for 2-3 minutes and on his return found the deceased head first in a cattle drinking trough. The lip of the trough was 12 inches above the surrounding manure level and contained 15 inches of water. The deceased was only 2ft 10in tall.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Occupier	D7 - Correct plan/procedure not chosen.
Parent	D7 - Correct plan/procedure not chosen.

Case No 234

A 72 year old self-employed farmer was using a two wheel drive tractor with a rear mounted mower. It is thought that whilst standing on the nearside of the tractor replacing tools under the seat he knocked the tractor into forward gear. The tractor moved forward knocking him down. As he fell he appears to have been able to knock the tractor out of gear. It stopped with the wheel resting on his chest asphyxiating him.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.

Case No 235

A 40 year old self-employed farmer was driving a two wheel drive tractor adjacent to a ditch across a slope, cutting thistles. It is believed that a mound on the upper side of the tractor's path increased the slope locally to 34^0 and initiated an overturn when driven over. The tractor turned through 450^0. The deceased stayed inside the cab and suffered multiple (fatal) injuries.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.

Case No 236

The 12 year old son of a farmer was riding back to the farm on the nearside mounting steps of a combined harvester. The base of the steps hit a stone, and lifted causing them to become unhooked. The deceased fell and was run over.

Coding:

Deceased	A1 - Correct response not in programme.
Machine Owner	C3 - Responsibility for implementing procedure not accepted.
Parent	C3 - Responsibility for implementing procedure not accepted.

Case No 237

A 72 year old retired member of the public was visiting a 'Pick Your Own' site. A steel framed tent-like shelter blew over onto the deceased causing a fracture in the pelvic regions and internal bleeding. Shock led to a fatal heart attack five days later. The deceased had had previous heart attacks.

Coding:

Deceased	E1 - Response not correctly executed.
Occupier	C4 - Need to test for danger not known/recognised.

Case No 238

A 76 year old self-employed farmer was driving a tractor and trailer across a field. He stopped to pick up a rope and on mounting the tractor appears to have knocked it into gear. He fell off but retained hold of the steering wheel. On reaching a hedge the deceased let go and was run over. He died seven days later.

Coding:

Deceased	D2 - Correct procedure not known.

Case No 239

The deceased a 64 year old farmer was standing in front of a tractor nearside rear wheel attempting to start the tractor in order to raise the hydraulics. The tractor was in gear, it started and ran over him.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 240

A 23 year old general farm worker was loading two fat cattle into a lorry when one kicked him. He stepped back, tripped and fell down the ramp striking his head.

Coding:

Deceased	E3 - Procedure not correctly executed.

Case No 241

A 64 year old self-employed farmer was driving a four wheel drive all terrain vehicle straight down a 45° slope. The front wheels hit a narrow sheep track causing the machine to somersault forward on to the deceased who had been thrown off, hitting his head on a rock. Operating instructions contained a warning about such situations but had not been read. Head protection would have probably prevented death.

Coding:

Deceased	D2 - Correct procedure not known.
Deceased	C3 - Responsibility for implementing procedure not accepted.

Case No 242

The deceased a 28 year old self-employed contractor was operating a big round baler. The deceased dismounted from the tractor leaving the drive to the bailer engaged and attempted to correct a fault in the knotting mechanism. Deceased was standing in smooth soled shoes on a smooth metal wheel when his arm was caught and pulled into the bale chamber. An operator's step designed to provide access to the knotting mechanism had been broken off and not replaced. The accident happened at 6 p.m. and the deceased had been working since 4 am.

Coding:

Deceased	C3 -	Responsibility for implementing procedure not accepted.
Deceased	C4 -	Need to test for danger not known/recognised.
Colleague (self-empl'd)	C4 -	Need to test for danger not known/recognised.

Case No 243

A 76 year old retired farmer's wife was assisting her son in hitching a cultivator to a tractor. She was between the tractor and cultivator when her son's foot slipped off the clutch, and the cultivator shot forward injuring her leg. She died some time later of a blood clot having refused to see a doctor for over a week after the accident. She was elderly and overweight.

Coding:

Deceased	C4 -	Need to test for danger not known/recognised.
Colleague (self-empl'd)	C3 -	Responsibility for implementing procedure not accepted.

Case No 244

The 24 year old nephew of the occupier and owner of an electric drill was using it to repair a fertiliser sprayer. The drill would not work so the deceased rewired the plug, transposing the red and green wires. On touching the metal casing he received fatal injuries. The drill had been on loan to the deceased for six months prior to the accident. It had been returned to the owner shortly before the accident but he had not checked it.

Coding:

Deceased	C4 - Need to test for danger not known/recognised.
Deceased	D2 - Correct procedure not known.
Colleague (not empl'd)	C4 - Need to test for danger not known/recognised.
Equipment owner	C4 - Need to test for danger not known/recognised.

Case No 245

Deceased a 53 year old tractor driver (but experienced stockman) and the Stock Manager entered a field to separate a 1-ton Charolais Bull from a herd of cows. They carried sticks but a refuge vehicle was not available. The bull suddenly turned on the deceased tossing him in the air and trampling him. This was a stock bull on a bull breeding unit who had always been docile.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	D7 - Correct plan/procedure not chosen.
Colleague (employee)	D7 - Correct plan/procedure not chosen.
Employer	D7 - Correct plan/procedure not chosen.

Case No 246

A 16 year old employed youth was trimming conifer branches adjacent to an 11 kV overhead cable. One branch pivoted and fell horizontally against the cable and the youth was electrocuted. Deceased was allegedly skilled, experienced and cautious but supervision appeared inadequate.

Coding:

Deceased	E3 - Procedure not correctly executed.
Employer	D7 - Correct plan/procedure not chosen.

Case No 247

A 13 year old boy was assisting his father a part-time commercial bee keeper to move some hives. He was wearing full beekeepers protective clothing but were stung through it on the neck. The deceased was an asthmatic, known to be allergic to bee stings and died as a result of a massive allergic reaction. His mother, brother and sister were all known to be allergic.

Coding:

Deceased	E3 - Procedure not correctly executed.
Parent	C6 - Need for action not recognised.

Case No 248

A 21 year old experienced jockey (90 races) was riding a horse in a hurdle race. The horse stumbled on landing after jumping the penultimate fence. The deceased was thrown and landed on his head. The horse then rolled on his body. The deceased was wearing a regulation safety helmet which remained in place but he still died with brain injuries.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	E3 - Procedure not correctly executed.

Case No 249

A 65 year old woman was severely injured whilst a member of the audience at an agricultural show when a Shire horse ran away and jumped the perimeter fence. She died unexpectedly six weeks later. An old twice broken and repaired throat strap had been used in an otherwise new harness for the 7 year old Suffolk gelding. When the horse became agitated (reason unknown) the strap broke releasing the horse from its handler's control.

Coding:

Deceased	E1 - Response not correctly executed.
Animal owner	C4 - Need to test for danger not known/recognised.
Employee	C3 - Responsibility for implementing procedure not accepted.

Case No 250

The deceased a self-employed 25 year old horsewoman was riding a horse on a roadway. The horse slipped and fell and she was thrown off landing on her head despite correctly wearing an approved helmet which appears to have remained in place. She died of diffuse brain swelling.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	E3 - Procedure not correctly executed.

Case No 251

The deceased was a 23 year old self-employed tree surgeon who was climbing a ladder to gain access to an oak tree in need of surgery. Despite wearing a harness and rope he was not tied on during climbing and fell about 7 metres on to a tarmacadam highway. He was not wearing a helmet. He died of multiple injuries. The main contractor had not enquired into nor assessed the deceased's competence in a structured way.

Coding:

Deceased	D2 - Correct procedure not known.
Employer	D7 - Correct plan/procedure not chosen.

Case No 252

The deceased was a 79 year old retired farmer who carried out odd jobs for his neighbours. He was on a ladder attempting to saw through a tree branch 5 metres above the ground. The branch pivoted when cut, fell on the hedge, and bounced back knocking the deceased from the ladder. He was not wearing a harness or head protection.

Coding:

Deceased	D2 - Correct procedure not known.
Occupier	C3 - Responsibility for implementing procedure not accepted.

Case No 253

Contractors were removing a hung-up tree in a private garden in which the deceased was employed as a gardener. He had been instructed to keep away and was thought to be working in another part of the garden. Unbeknown to the contractors he wandered into the area where the tree was being taken down just as it fell and he sustained multiple injuries.

Coding:

Deceased	E1 - Response not correctly executed.
Employer	E7 - Plan/procedure not correctly executed.
Supplier of service	E3 - Procedure not correctly executed.

Case No 254

The deceased a 53 year old farmer was preparing a crawler tractor for work levelling some landfill on his farm. The engine was started which caused a prop used to support the hydraulic bucket to be displaced, hitting and knocking him down. The bucket then descended and decapitated the deceased. A manufacturers ram stay was not available.

Coding:

Deceased	E1 - Response not correctly executed.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Colleague (self-empl'd)	E3 - Procedure not correctly executed.

Case No 255

The deceased was a 50 year old forestry contractor (12 years as a Chartered Forester). He was supervising the felling of a tree in the fork of which a branch from a previously felled tree had lodged. As the tree fell he suddenly stepped forward and was hit on the head by the loose branch which probably weighed no more than 50 kilograms. The deceased was not wearing head protection and was too close to the felling position.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Deceased	C3 - Responsibility for implementing procedure not accepted.
Self-employed	C3 - Responsibility for implementing procedure not accepted.
Occupier of land	C4 - Need to test for danger not known/recognised.

Case No 256

A 39 year old self-employed tree surgeon appears to have inadvertently cut through his lifeline whilst up a tree and falling 9m to his death. He was a very experienced, competent and college trained.

Coding:

Deceased	E3 - Procedure not correctly executed.

Case No 257

A self-employed farmer was working alone preparing a potato harvester (guarded to the standard of the Field Machinery regulations) for work, in February. Whilst cleaning and making adjustments beneath the machine whilst it was in motion the deceased was caught in the clod roller assembly. He died of multiple injuries and was not found until the next day.

Coding:

Deceased	C3 - Responsibility for implementing procedure not accepted.
Designer	C6 - Need for action not recognised.

Case No 258

The deceased was a 28 year old employee. He was driving a dumper truck and engaged in constructing a path adjacent to a reservoir. It was his first day with a new machine, which turned over trapping him underwater. He had not received instruction, edge protection was not provided, nor were there adequate arrangements for tipping the soil.

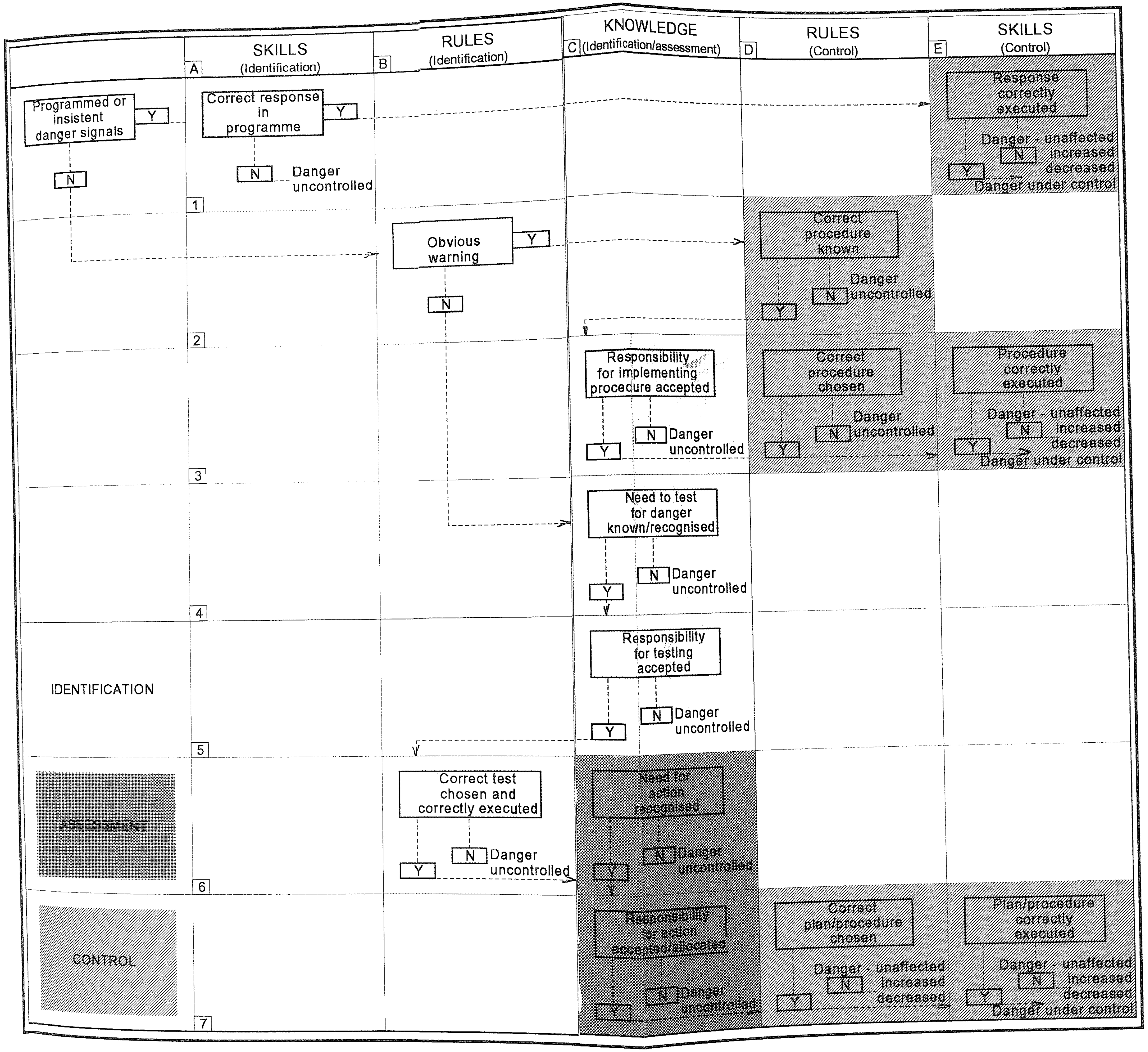
Coding:

Deceased	E1 - Response not correctly executed.
Deceased	D2 - Correct procedure not known.
Employer	C3 - Responsibility for implementing procedure not accepted.

Appendix 2

Accident causation matrix

(Developed from the Hale and Glendon accident causation model.)



SKILLS (Identification)
RULES (Identification)
KNOWLEDGE (Identification/assessment)
RULES (Control)
SKILLS (Control)
A
B
C
D
E
Programmed or insistent danger signals
Y
N
Correct response in programme
Danger uncontrolled
Response correctly executed
Danger - unaffected increased decreased
Danger under control
1
Obvious warning
Correct procedure known
2
Responsibility for implementing procedure accepted
Correct procedure chosen
Procedure correctly executed
3
Need to test for danger known/recognised
4
Responsibility for testing accepted
IDENTIFICATION
5
Correct test chosen and correctly executed
Need for action recognised
ASSESSMENT
6
Responsibility for action accepted/allocated
Correct plan/procedure chosen
Plan/procedure correctly executed
CONTROL
7