SAFETY ATTITUDES IN NEW ZEALAND FORESTRY

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ABSTRACT

This study examines the attitudes towards safety, held by workers, contractors, supervisors, and managers employed in the New Zealand forest industry. The study follows the framework offered by Purdham (1984, cited in Cox & Cox, 1991), which divides safety attitudes into safety hardware, safety software, people, and risk. After a review of the literature relating to these object areas, attitudes, and safety, a safety attitude questionnaire that was developed specifically for the study is described.

The questionnaire was administered to 465 people working in the forest industry. The results suggested that the structure provided by Purdham, as well as Cox and Cox (1991) is not entirely apparent, however it can be used to evaluate safety attitudes. Attitudes towards safety hardware were very positive although a number of workers were unaware of the benefits of more recently developed personal protective equipment. Attitudes towards safety software were slightly negative. Many workers were unaware of safety policies and the Health and Safety in Employment Act 1992, and were of the opinion that there was conflict between safety and other job demands.

With regards to people, all groups surveyed had very good attitudes towards responsibility, and realised the importance of safety. Attitudes towards risk were reasonable, but knowledge of objective risk was poor. Results also suggested that the safety climate is rather negative, with many workers not believing that management or their work-mates were committed to safety. Management were also of the opinion that workers would not believe they were committed to safety.

The survey found no relationship between individual attitudes and accident involvement. Training, education, and experience were also unrelated to accident involvement. Finally, management appear to be making attribution errors with regards to the cause of accidents. The implications of these findings for the forest industry, and safety research are discussed.

FOREWORD

Forestry is a major export earner for New Zealand accounting for 10% of total exports (NZFOA, 1992). In 1992, NZ plantation forests covered 1,239,886 hectares, 90% of this is pinus radiata. These forests are usually established at stocking rates of between 800 and 1200 stems per hectare (Gaskin, 1990). To maximise the volume harvested at clearfell, the number of stems per hectare are reduced to final stocking rates of 200 to 350 stems as early as possible (five or six years old). At the age of 30 years, stem masses average around 2.5 tonnes and have very heavy branching. Due to this heavy branching, weight, and the difficult terrain found in many New Zealand forests, mechanised felling and delimbing is often unsuitable, so motor-manual techniques with chainsaws must be used.

The forest industry can be divided into two divisions; logging and silviculture. The term logging is used to describe the process of felling and delimbing trees, dragging or hauling the delimbed trees (stems) to a landing, cutting the stems into graded logs, and loading the logs onto trucks for transportation. Silviculture is used to describe the growing and tending of forest crops. Silviculture jobs include seed collecting, planting trees, thinning to waste, pruning, fertilising, and spraying.

One of the major problems facing the forest industry is the high number of occupational injuries that occur in logging and silviculture. To help address this problem, the Logging Industry Research Organisation (LIRO) has been undertaking research in occupational health, safety, and ergonomics since 1983. In 1993, LIRO received funding from the Foundation for Research, Science, and Technology, to examine forest workers' attitudes towards accident investigations. The author put forward a proposal to expand the study to cover attitudes towards safety in general. This proposal was accepted by LIRO and the forest companies concerned. The author was then employed by LIRO to carry out the study in conjunction with Massey University. As a result, this study has been strongly influenced by the needs of the forest industry, and the practical constraints of conducting research in an applied setting.

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1 - INTRODUCTION

Safety and health in occupational settings is a subject of increasing concern and attention (Kaplan & Burch-Minakan, 1986; Sherry, 1991). This rising level of concern is due to a number of factors: occupational injury rates have reached a 12 year high in the United States (Hansen, 1993), reported accident costs for firms are increasing at an annual rate of 15% (Brody, Léfourneau, & Poirier, 1990), and the potential damage that could occur if safety engineering designs fail is now catastrophic (Dwyer, 1992). In New Zealand, the Department of Labour (1993) reported that the total cost of occupational accidents is approximately NZ$ 1 to 1.5 billion, or 2% of Gross Domestic Profit (if medical costs, loss of wages, loss of productivity, and factors such as retraining are taken into account). In 1992-1993, claims for all occupations in New Zealand cost the Accident Compensation Corporation (ACC) NZ$ 520 million, and this figure is increasing each year (Department of Labour, 1993).

One industry that has a very high accident rate both internationally and in New Zealand is forestry (Pettersson 1981; Crowe, 1986; Gaskin, 1988; Forestry & Wood Industries Committee, 1991; Salisbury, Brubaker, Hertzman, & Loeb, 1991). In New Zealand, Gaskin (1988) reported a fatality rate in logging of 2.3 per 1000 workers per year for the period 1968 through to 1987. This is 33 times higher than the national average fatality rate of 0.07 per 1000 workers per year.

The fatality rate in logging has not improved over recent years. Within a work-force of just 2500 people (New Zealand Forest Owners Association, 1993a), there were 7 logging fatalities in 1991, and 9 fatalities in 1992 (Parker, 1993a). In the 1992-1993 financial year, the Occupational Safety and Health Service of the Department of Labour reported that 11 people had been killed in logging accidents in New Zealand (Occupational Safety & Health Service, 1993). The fatality rate in silviculture is much lower than in logging, but still twice the national average (Cryer & Fleming, 1987).

Unfortunately, the high number of fatalities is only part of the safety problem. The Logging Industry Accident Reporting Scheme (ARS) recorded 197 lost-time accidents in 1992 and it is suspected that a large number of accidents do not get reported to this scheme. ACC expenditure on forestry claims totalled NZ$ 8 million in 1992, which suggests that a very large number of injuries must be occurring. More than half of this cost was for sprain and strain injuries (Accident Compensation Corporation, 1994).

In an attempt to reduce the rising costs of funding New Zealand's accident compensation scheme and improve occupational safety, the New Zealand Government has introduced two new Acts; the Accident Rehabilitation and Compensation Insurance Act 1992 (ARCI Act) and the Health and Safety in Employment Act 1992 (HSE Act).

The ARCI Act introduced a levy system based on the New Zealand Standard Industry Classification (NZSIC) system. Under the NZSIC system, jobs are divided into 28 classes with each class being charged a specific accident levy. An experience rating system was also introduced so that employers are charged an additional levy, or given a rebate, based on their past accident claim history which is compared with their class average.

The HSE Act requires the employer to provide a safe work environment and minimise the risk of employees having work-related accidents. To encourage a safety management system at work, the Act permits fines of up to NZ$ 100,000 and/or one year imprisonment to be imposed on employers who fail to abide by the Act. If an accident occurs, it does not matter if the employer did not know of the hazard, the fact that an accident did occur means that the employer could be prosecuted. To avoid conviction, the employer must prove that all practical steps were taken to control all significant hazards.

These Acts have important implications for the forest industry as it must now provide a safe work environment and take all practical steps to eliminate significant hazards, or receive possible fines and increased levies. This will be difficult to achieve in an environment comprising of steep rugged terrain, undergrowth, falling trees, rolling logs, broken branches, and heavy machinery. Poor ergonomic conditions that include continual loud noise, vibration, fumes, and bad work posture, as well as weather conditions which range from below freezing to extremely hot, add to the hazards faced by the workers.

Due to the high number of significant hazards in New Zealand forests, the only plausible method of eliminating or isolating many hazards is through mechanisation of forestry operations. Mechanised harvesting removes the majority of dangerous hazards by placing the worker in a cab, but a variety of problems have made mechanised harvesting an unpopular option in New Zealand.

Mechanisation is extremely difficult in the steep terrain that is found in many New Zealand operations. Another problem is the general trend toward reducing the number of trees per hectare to the final stocking rate as early as possible. This practice results in trees with large diameters and very heavy branching which are unsuitable for mechanised harvesters (Gaskin, 1990). This means that motor-manual systems, involving workers using a chainsaw, must continue to be used for the felling and delimbing tasks which currently account for 55% of lost-time injuries (Gaskin & Parker, 1993).

The New Zealand forest industry must find other means of reducing or controlling the hazards workers must face. This is presently being addressed through training and research. The Logging and Forestry Industry Training Board (L&FITB) is developing and implementing Forest Industry Record of Skill (FIRS) training modules to improve working techniques and enhance the safety behaviour of forestry workers. Research examining ergonomics and occupational safety and health in forestry is being undertaken by the New Zealand Logging Industry Research Organisation (LIRO). Research projects have focused on reducing the physiological workload placed on forestry workers, the ergonomic evaluation of machinery, the effectiveness of protective footwear, the development of chainsaw trousers and high visibility clothing. LIRO also maintains an accident reporting scheme (ARS) for the industry.

LIRO's research efforts have had a notable effect on safety. For example, Gaskin and Parker (1993) reported that the severity of chainsaw lacerations has been reduced since the introduction of chainsaw chaps. However, improving safety through job and equipment redesign does have its limitations (Dwyer, 1992). Snook (1978) estimated that job redesign can eliminate 33% of manual handling errors, which still leaves 67% of errors unaccounted for. Near-miss accident reporting schemes also have limited effectiveness in reducing accidents. Guastello (1993) examined two near-miss accident reporting programmes and found they had no effect on the accident rate, although one programme did reduce the severity of injuries.

It appears that further research examining other possible interventions is required if any substantial impact on the accident rate in forestry is to be achieved. Two areas that currently receive very little attention are the psychological aspects of forestry work and the psychological characteristics of the work-force (Slappendel, Laird, Kawachi, Marshall, & Cryer, 1993). The only psychological area that has been examined in detail is workers' perceptions of risk (Dunn, 1972; Ostberg, 1980; Tapp, Gaskin, & Wallace, 1990). Dunn (1972) suggested that some accidents occur due to workers underestimating the risk involved with some aspects of their jobs. In New Zealand, Tapp *et al.* (1990) found that loggers did know which aspects of their jobs were the most dangerous, and which part of their body was most likely to be injured. This raised the question, why do loggers take risks?

An answer to this question may be found by examining the attitudes of the personnel who work in the forest industry. A vast amount of safety research has been devoted to understanding and changing attitudes (Farmer & Chambers, 1939; Griffeth & Rogers, 1978; Zohar, 1980; Murphy, 1981; DeBobes, 1986). Early studies of safety attitudes concentrated on trying to identify accident prone individuals. Worick (1978, cited in Murphy, 1981) stated that faulty habits and attitudes are the prime accident producers. It was assumed that attitudes were strongly linked with behaviour, therefore changing attitudes would lead to a change in behaviour. This assumption, along with the concept of accident proneness soon became very popular, despite little empirical support (Hale & Glendon, 1987).

However, research in social psychology showed that attitudes were not strongly linked with behaviour (LaPiere, 1934; Wicker, 1969). Howarth (1988) noted that attitudes are often easier to change than behaviour, and a change in attitude does not always reflect a change in behaviour. Furthermore, researchers began criticising the large number of safety programmes that were based upon changing attitudes, as these programmes often had little success at reducing accidents or improving safety (Murphy, 1981; Sutherland, Makin, Phillips & Cooper, 1993; Guastello, 1993).

Recently, interest in an organisational safety "climate" or "culture" has caused a renewed interest in employees' attitudes towards safety (Cox &

Cox, 1991). Rather than concentrate on attitudes as a means of identifying accident prone individuals, attitudes are seen as a way of understanding the safety climate of an organisation (Zohar, 1980; Cox & Cox, 1991; Dedobbeleer & Béland, 1991). Studies examining attitudes towards safety have also provided valuable information for improving personal protective equipment (Allegrante, Mortimer, & O'Rourke, 1980; Feeney, 1986) and implementing successful safety systems (Smith, Cohen, Cohen, & Cleveland, 1978; Griffiths, 1985; Stoley, 1993).

Currently, the New Zealand forest industry has little knowledge of its safety climate, or the psychological characteristics of their work-force. To address this lack of knowledge, this study was undertaken to examine the attitudes towards safety held by members of the New Zealand forest industry. As both safety and attitudes are highly complex concepts, Purdham's (1984, cited in Cox & Cox, 1991) framework is used. Purdham divided attitudes towards safety into four different object areas: safety hardware (work environment and protective equipment), safety software (safety policies and concepts), people, and risk. These four object areas, and attitudes towards accident investigations are examined in detail. The final goal is to provide information that will help companies implement effective safety systems aimed at changing attitudes, behaviour, and ultimately, reducing accidents.

This study has been organised in the following manner. Chapter 2 summarises the contemporary psychological literature on attitudes, and explains how they are developed, maintained and changed. The relationship between behaviour and attitudes is described, followed by a brief discussion on attitude measurement.

Key research on attitudes towards safety and the psychological factors associated with these attitudes are described in Chapter 3. Literature examining safety hardware, software, risk and people is reviewed, and research regarding how safety can be improved is presented.

The research design is described in Chapter 4. Objectives and hypotheses are presented, followed by the procedures involved in developing a suitable questionnaire. Sampling and analytic strategies are also discussed.

Results from the survey are presented in Chapter 5, with the aid of tables. Firstly, the demographic data are summarised followed by results for individual attitude questions. Results from the factor analysis and the construction of attitude scales are then presented. The differences between various groups are tested for significance using *t* -tests, chi-square, and one-way ANOVAs.

Chapter 6 discusses the implications of the results in relation to the four object areas of safety. The relationship between demographic variables, attitudes, and accidents is then discussed. Attitudes towards accident investigation procedures are examined in the final section. A number of problems are identified and discussed including attribution errors, and the psychological aspects of the work which must be taken into account when investigating accidents.

The final chapter summarises the forest industry members' attitudes towards safety. A safety strategy is described which should help improve the problem areas identified in this study. This is followed by some recommendations for future research.

CHAPTER 2 - ATTITUDES AND ATTITUDE CHANGE

2.1 INTRODUCTION

Attitudes have been a key concept of social psychology since the early 1920's. Understanding how attitudes change is of vital interest to many groups and organisations who wish to influence the behaviour of others, including areas such as advertising, education, and businesses. Despite the large amount of research, there is still debate over the structure of attitudes, how they develop and change, and whether they are related to behaviour. These issues are discussed within this chapter. Definitions of attitudes are presented along with distinctions between attitudes, values, and beliefs. The importance of attitudes is discussed through an examination of their influence on human information processing. Attitude formation and change is briefly described, followed by a discussion on the most common means of attitude change, namely persuasion. The relationship between attitudes and behaviour is described and the final section discusses attitude measurement.

2.2 ATTITUDE STRUCTURE

Of particular importance in the study of attitudes has been the concept of an underlying attitude structure. Over the years, a variety of uni-dimensional versus multi-dimensional, and operational versus conceptual, definitions have been proposed to describe attitudes. For example, Allport (1935) described an attitude as "a mental and neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related" (p.810). Others (eg. Katz & Stotland, 1959) deny that attitudes imply any overt behaviour and focus on the affective tendency to evaluate objects.

Due to the lack of agreement over a definition, and the conflicting results of research, some researchers such as Nuttin (1974), have questioned whether the term "attitude" should be used at all. However, in a recent review of attitude research, Olson and Zanna (1993) stated that modern influential theorists generally agree that:

- Attitudes express an evaluation of an entity.
- These evaluations are represented in memory.
- Attitudes consist of affective, cognitive, and behavioural predispositions.

These theorists agree that attitudes are not formed until an individual responds evaluatively to an entity. Evaluation is considered to be the key concept of an attitude, as without it, attitudes cannot exist. An individual must express a degree of favour or disfavour towards an entity. This response can be overt or covert, and expressed in either affective, cognitive, or behavioural forms.

Advances in cognitive psychology support the belief that attitudes are represented in memory. There are various theories that explain how this is done. The two most common theories propose that attitudes are either knowledge structures, or alternatively, associative networks of interconnected evaluations and beliefs. These two theories imply that eliciting a certain attitude will make closely associated attitudes more accessible through a process of "spreading activation". The socio-cognitive model proposed by Pratkanis and Greenwald (1989) explains how this can be achieved. The attitude is represented in memory by an object label, an evaluative summary, and a knowledge structure which supports the evaluative summary. This allows attitudes to serve a variety of functions such as problem solving, organising memory of events, and maintaining self-worth.

The affective, cognitive, and behavioural components of attitudes were identified by Osgood, Suci, and Tannenbaum (1958) through a series of factor analytic studies. The affective component refers to an individual's feelings and emotions about the object (or entity) of the attitude. Although the affective component appears to be similar to the evaluative component discussed above, Breckler and Wiggins (1989) and Zanna and Rempel (1988, cited in Tesser & Shaffer, 1990) demonstrated that they were distinct. The cognitive component refers to how the object is perceived by the individual, and the behavioural component refers to an individual's behavioural tendencies regarding an object. McGuire's (1969) review of the literature suggests that these three components are highly correlated.

Although these components had a dominant role in attitude research (Triandis, 1971; McGuire, 1969), contemporary research has questioned the old tripartite definition of attitudes (Tesser & Shaffer, 1990). Attitudes are rarely operationalised in terms of the tripartite definition, and due to the problems associated with dividing attitudes into three components, Olson and Zanna (1993) recommended that the affective, cognitive, and behavioural domains should be considered as correlates of attitudes rather than components. Attitudes can be based upon, or developed from affective, cognitive, and behavioural information and can also be expressed in the form of affective, cognitive, and behavioural responses, but all three predispositions do not necessarily apply to any given attitude.

Attitude Characteristics

Three important characteristics of attitudes noted by Olson and Zanna (1993) are accessibility, strength, and ambivalence. When attitudes are easy to recall, for example a friend reminds an individual of their attitudes against drunk driving, the attitudes become highly accessible. Highly accessible attitudes are more likely to influence behaviour and bias interpretation of relevant information.

Krosnick and Ahelson (1992, cited in Olson & Zanna, 1993) identified five dimensions that reflect attitude strength: extremity, intensity, certainty, importance, and knowledge. Strong attitudes are harder to change, affect perception and behaviour, and are important sources of identity. The third characteristic, ambivalence, is when attitudes consist of a complex mix of both positive and negative elements or evaluations. For example, a person may respect and like someone, yet also fear that same person.

The Function of Attitudes

Attitudes can serve two major functions. Firstly, they can help individuals categorise objects and events, providing simplified guidance for the appropriate behaviour towards specific objects. This is called object appraisal or the economy function. Secondly, attitudes can communicate important values, serving an expressive function, providing an outlet for emotions and a means of identity.

McGuire (1969) identified two other functions that attitudes may serve: the utilitarian and ego defensive functions. The utilitarian function states that attitudes dispose individuals towards objects and paths that are instrumental in achieving one's goals. The ego-defensive function presumes that attitudes may help individuals deal with inner conflicts, rather than the object of attitudes. Some people may be racist, not because of anything to do with the other race, but due to inner needs such as the need to dominate or be aggressive. The recent emphasis on attitudes as an individual's evaluation of an object that is represented in memory, has led to the view that the main purpose of attitudes is object appraisal. Even the self-expressive function may be classified as object appraisal of oneself.

Distinctions between Attitudes, Beliefs, Knowledge, and Values

It is useful to differentiate attitudes from beliefs, knowledge, and values. Belief was defined by Fishbein and Raven (1962) as a probability dimension of a concept. Attitudes may include beliefs, but also include an evaluation dimension which makes them distinct. Knowledge helps form our attitudes and generally makes up the cognitive component, but knowledge by itself is not evaluative. Perhaps the best distinction between values and attitudes was presented in the section above on attitude functions; attitudes communicate values. Values can also be seen as either a broader attitude, a component of attitudes, and others have suggested that they are all points along a single continuum (Allport, 1937, cited in McGuire, 1969).

2.3 ATTITUDES AND INFORMATION PROCESSING

It has been argued that attitudes can influence all the steps in information processing including attention, encoding, comprehension, interpretation, elaboration, and memory. Sanbonmatsu and Fazio (1990) found that as the motivation to make the correct decision decreases, the likelihood that attitudes will guide memory-based decision making increases. Not surprisingly, many studies have demonstrated that humans are often biased when processing information. For example, when coffee and non-coffee drinkers were exposed to high and low threat messages on the health consequences of caffeine, Liberman and Chaiken (1992, cited in Olson & Zanna, 1993) found that coffee drinkers appeared to process the threatening parts of the message in a biased fashion. Further evidence was provided by Houston and Fazio (1989) in a study of attitudes towards capital punishment. If the subjects attitudes were highly accessible, their attitudes predicted how they would evaluate the capital punishment studies.

Individuals find that information which supports their attitudes is easier to learn and remember than information which contradicts their attitudes (Olson & Zanna, 1993). Attitudes can also affect memory reconstruction. Persuading subjects that too much tooth brushing is harmful caused subjects' estimates of previous tooth brushing to drop (Ross, 1989). Ross suggested that people believe attitudes are stable and are consistent with behaviour, so if an attitude is altered, people incorrectly believe that they have always believed in their new attitude. Loftus and Loftus (1980) also noted that human memory was unreliable as changing the way a question is asked can have a substantial affect on the information that is recalled.

2.4 ATTITUDE FORMATION AND CHANGE

A number of explanations of attitude formation and change have been advanced within psychology. These include: genetics, physiological conditions, and total institutions; learning, perceptual, consistency, and functional theories; persuasive communication; and behavioural theories. Each of these explanations are described briefly below.

The Role of Genetics in Attitude Formation

In the past, most researchers rejected the notion that genetic factors could explain attitude formation or change, as such ideas were associated with negative consequences. For example, if attitudes towards racial discrimination were inherited it was feared that they could not be changed. In a study of job satisfaction using twins, Arvey, Bouchard, Segal, and Abraham (1989) estimated that 20% of the observed variance in job satisfaction could be attributed to genetic factors. Eaves, Eysenck, and Martin (1989, cited in Olson & Zanna, 1993) report findings from a number of studies which suggest heritability estimates ranging from 0 to 50% of the observed variance. Attitude items relating to the treatment of criminals produced the highest heritability scores, whereas items relating to socialism were largely influenced by family environments.

Behavioural genetics has provided some research that indicates some attitudes may be inherited. Tesser (1992) argues that heritability is an important factor with highly heritable attitudes being more resistant to change. One does not want to enter into the nature - nurture debate here as this is another complex issue. It is, however, important to note that genetic findings do not necessarily imply that there are certain genes producing specific attitudes. Other biological factors such as body chemistry and physical composition could explain the findings. Whatever the result, the conclusions do not have to be negative. Just because genetics may play a role in attitudes does not mean they cannot be changed, and just as many positive attitudes could be affected by genetic factors than negative attitudes.

Physiological Conditions and Attitude Change

Physiological conditions such as aging, illnesses, and drugs can also influence attitudes. Studies examining human development suggest that attitudes definitely change as a person progresses through life. Systematic shifts have been noted to occur in individuals' levels of dominance, aggressiveness, competitiveness, conformity, independence, and other general tendencies (McGuire, 1969). Different illnesses have a wide variety of effects on attitudes. Tuberculosis is associated with optimism, epilepsy with distrustfulness. Fatal illnesses can definitely change attitudes, but this is probably due to the final outcome rather than the disease itself. Drugs such as opiates, barbiturates, and tranquillisers reduce a person's contact with social reality. People on such drugs may have feelings of euphoria and have less social anxiety so they are more likely to hold deviant opinions. Physiological conditions are not responsible for all the attitude change, but there is evidence of their influence.

Total Institutions, Attitude Formation, and Change

Total institutions can cause attitude formation by controlling what stimuli an individual receives, what responses are possible, and what rewards and punishments will be given. Long term imprisonment and certain mental institutions are examples of such environments. Another common example is early childhood where a family may control all stimuli a child receives, thus having a major impact on the child's attitudes.

Learning Theories

Learning theories follow the commonsense notion that attitude change will occur following the learning of persuasive material. To predict the relationship between a given independent variable and attitude change, the known relationships of that independent variable to learning needs to be examined. For example, the effectiveness of fear appeals in persuasion will be predicted on the basis of known anxiety-learning relationships (McGuire, 1969).

McAlister (1987) applied Bandura's (1982) social learning theory to safety. This theory takes into account the social pressure to conform or act in a certain way, and shows how people can learn behaviour through modelling (watching and copying the behaviour of others).

A problem with learning theories is that they may predict attitude change, but fail to predict the relationship to the learning variable which was supposed to be the basis for the attitude change. This suggests a correlation between learning and attitude change, rather than a causal relationship.

Perceptual Theories

Perception theories stress changing perceptions about a given object, rather than changing the attitude itself (Asch, 1948). If an individual who thinks poorly of sports people discovers that their valued peers hold sports people in high regard, then that individual is likely to express more favourable attitudes towards sports people. To justify this change in attitude, the individual may broaden their definition of what constitutes a sports person. They may have originally only included professional sports people, and then broaden their definition to include social players. As the individual has a positive attitude towards social players, their attitude towards sports people is now more positive. Therefore, this theory states that attitude change does not occur, only perceptual change.

Consistency Theories

The basic assumption of consistency theories is that people behave in a way that maximises consistency between their own cognitive systems, and between their cognitive system and overt behaviour. The most popular consistency theory is Festinger's theory of cognitive dissonance. Festinger (1957) proposed that every decision in our lives is followed by a state of cognitive dissonance. Cognitive dissonance is hard to define, however the best description seems to be what a person feels when they ask themselves "Did I make the right decision?" This dissonance is caused by being aware of the positive aspects of the rejected alternative decisions, and the negative aspects of the selected decision. To reduce the dissonance, attitudes are changed in favour of the selected decision. If a person buys a car, the features that the car has will become more important when justifying the rejection of another car. Scher and Cooper (1989, cited in Olson & Zanna, 1993) argued that dissonance occurs when individuals feel responsible for aversive outcomes, and will occur whether the behaviour that caused the aversive outcomes was consistent or inconsistent with the individual's attitudes.

Functional Theories

Functional theories are more concerned with an individual's underlying motivational and personality needs rather than their information, perceptions or behaviours towards an object (Katz, 1960). Attitude change is achieved through changing these underlying needs, rather than the attitude directly. This theory appears limited as it states that attitude change does not occur, just a definitional change. However, the studies in this review suggest otherwise (Zimbardo, 1960; Ross, 1989; Millar & Millar, 1990). For example, it is hard to believe that subjects in Ross' (1989) study changed their definition of tooth brushing, rather than their attitude.

In summarising the attitude theories described above, McGuire (1969) stated that while they are all plausible, none appear to have any great amount of empirical validity. One common element in the theories above is that they all involve some form of persuasive communication. Many studies have concentrated on understanding persuasion. These studies are described in the following section.

2.5 PERSUASION

The most common method employed to change attitudes is persuasive communication. The two dominant theories on persuasion are the elaboration-likelihood model (ELM) by Petty and Cacioppo (1986) and the heuristic systematic model (HSM) by Chaiken (1987, cited in Tesser & Shaffer, 1990).

The elaboration likelihood model states that if people are highly involved in an issue or are analytically inclined, they are more likely to think about a message, elaborate on it, and be influenced by their thoughts. Research examining heuristics has found that individuals economise when issues are not important and use simple decision rules. The key to both theories is that when people are motivated and able to think about the message, persuasion will be more effective. Under such conditions, argument strength is the most important factor in determining whether persuasion occurs. If attitude change does occur it will be fairly stable and enduring. If individuals are not motivated or unable to process the message carefully, other cues and heuristics take priority (such as attractiveness of the source) with resulting attitude changes generally being less stable (Olson & Zanna, 1993).

Persuasive communication requires a source, message, channel, and receiver. The source is the person (or people) delivering the message. The message is the information to be communicated to a receiver. The channel is the form of communication (radio, television, newspaper, informal conversions), and the receiver is the individual or audience that the message is targeted for. The characteristics of each of these components are discussed below.

Source

There are a number of source characteristics that lead to greater attitude change. Higher levels of credibility, attractiveness, and power are all related to greater attitude change. Credibility consists of expertise, trustworthiness, and objectivity. Sources that speak confidently and quickly are viewed as more credible and perceived competence is more important than trustworthiness. Credible sources will persuade individuals with arguments that the individual can accept (internalisation). Although low credibility sources are not as persuasive as highly credible sources, it is possible for their impact to increase over time. This phenomena, called the sleeper effect, occurs if the message is remembered but not the reasons for discounting it (Pratkanis, Greenwald, Leippe, & Baumgardner, 1988).

Attractive sources are liked by the audience, either through similarity, familiarity, or physical features. Attractive sources persuade individuals through identifying a role relationship between themselves and the audience (identification). In matters of subjective preferences (values, tastes), attractive communicators are more effective than credible (and unattractive) sources. On judgements of objective reality (facts), credible dissimilar sources are more effective (Goethals & Nelson, 1973). Good arguments are more important for an expert source than an attractive non-expert because their ability to persuade rests on the strength of their arguments. Although familiar sources are generally more persuasive than unfamiliar ones, there are exceptions to the rule. Children's behaviour can be influenced more by a stranger's social reinforcement than by familiar people.

Power of a source is assessed by the amount of positive and negative rewards a source may deliver, how much the source cares about compliance with the message, and how likely the source can monitor or observe that compliance has been achieved. Although power achieves public attitude change, private attitudes may remain the same. A parent may prevent their children from smoking by using power, however the child's own attitude towards smoking may remain unchanged. As a result, behaviour may be situationally dependent. For example, children may smoke with their friends but refrain from smoking around their parents.

Message

A number of factors affect an individual's ability and motivation to process messages. Message context and structure, the kind of appeal used, the order that the material or appeal is presented, how opposition arguments are dealt with, plus encoding and reception, all affect persuasion. Message and source characteristics can also interact with one another. For example, if a message is difficult to comprehend, source credibility affects the level of agreement with attitudes conveyed.

Mackie and Asuncion (1990) distinguished between on-line and memory-based attitude change to examine the effects of message content recall on persuasion. If subjects were given tasks that inhibited processing of the message, attitude change was related to recall of the message. If subjects were allowed to elaborate on the message as it was presented, actual message recall was not related to attitude change.

Conditioning can be a powerful tool in attitude change. Kuykendall and Keating, (1990) altered judgements of the favourability of economic conditions in countries by pairing names with positive or negative words. Maddux and Rogers, (1980) showed the greater number of arguments presented, the greater the attitude change although boredom can be a limiting factor. Support for repeating strong arguments or exposures to a message was also found by Cacioppo and Petty (1989, cited in Olson & Zanna, 1993). If the argument of a message is strong, then three auditory exposures increased persuasion over one exposure. If arguments were weak, then repeated exposures weakened the effectiveness of appeals. Just repeating a message can lead to greater evaluations of truth when compared to non repeated statements (Arkes, Boehm, & Xu, 1991).

There is some support for the sufficiency principle which assumes that individuals will only engage in whatever amount of deliberation that is required to provide them with sufficient judgmental confidence (Maheswaran & Chaiken, 1991).

Encouraging people to remember their own experiences with an attitude object (self-reference) increases persuasion. Such forms of elaboration can interact with other characteristics of the message such as discounting appeals. When elaboration is minimal, positively framed messages are more effective than negatively framed messages. The reverse is true if elaboration is extensive.

There are no general rules on whether to use rational or emotional arguments, or one sided versus two sided arguments as it depends upon the audience. Whether to advocate an extreme position or a mild one depends on the credibility of the source (Aronson, Turner, & Carlsmith, 1963). Primacy effects are generally stronger than recency effects, unless a long period of time passes between messages.

The "foot-in-the-door" phenomenon is a widely used technique in persuasion. This is the tendency of people who agree to a small request to later agree to a larger request. If originally approached with the large request they would not have complied (Myers, 1990).

Finding whether an attitude is based upon affective or cognitive information could be important when trying to change attitudes. Edwards (1990) found affect-based attitudes showed greater change when affective persuasive appeals were used. However, Millar and Millar (1990) found greater attitude change occurred when the persuasive appeals did not match the basis (affect or cognition) for the attitude. These contradictory results were explained by Olson and Zanna (1993) by hypothesising that for well-established attitudes, greater attitude change would occur when the appeals did not match the basis. If attitudes are newly formed, then it is best to match the basis of the attitude and the persuasive appeal as subjects have not had time to build up defensive counterarguments. Millar and Millar used well-formed attitudes so subjects would have built up protective counterarguments against messages that matched their attitude. Using messages that did not match the basis of the attitude would be more successful.

Mild threat appeals that arouse some level of fear can aid in persuasion. Protection motivation theory by Rogers (1983, cited in Olson & Zanna, 1993) explains four conditions that need to be present for threat appeals to be persuasive.

(1) The problem has to be serious.
(2) The recipient needs to be susceptible to the problem.
(3) Recommendations need to show how to avoid the problem.
(4) The recipient needs to be capable of carrying out the recommendations.

It is possible that fear arouses a general protection motivation and this could affect processing of all safety-related messages (Olson & Zanna, 1993). However, over arousing fear may lead the audience to pay no attention to the message because they do not want to believe it.

Channel

Communication can be achieved through a variety of means: training, television, video, books, interviews, newspapers, conferences and informal conversations. The type of media does not seem to play a major role in attitude change (Wiegman, 1989). While personal contact is superior to any form of media, the media still has a powerful influence as people often gain their information through the media, then pass it on in a two-step flow of communication.

Personal involvement can increase the effectiveness of persuasion but the relationship, as expected in attitude research, is not simple. Participation by individuals leads to greater attitude change than non-participation (Zimbardo, 1960). With cogent messages, Petty and Cacioppo (1986) found greater persuasion was achieved with high involvement than with low involvement. The opposite was achieved with specious messages; low involvement was related to higher persuasion. Petty and Cacioppo's study is worth noting to make it clear that involvement does not necessarily lead to greater persuasion. McGuire (1969) noted that communication is just as persuasive, or more persuasive, when a receiver has to passively read a conclusion, than when the conclusion must be drawn by the receiver through active participation.

The use of subliminal (not consciously recognised) messages has been made possible with modern communication channels such as television and videos. Krosnick, Betz, Jussim, Lynn, and Stephens (1992) exposed subjects to a subliminal presentation of an affect-arousing photograph after they had viewed slides of a young woman carrying out everyday activities. Subjects exposed to positive subliminal photos expressed more favourable attitudes towards the young woman than those subjects that were exposed to negative subliminal photos. The use of subliminal messages is receiving a great deal of attention in the media regarding the ethics of such methods in advertising or campaigning.

Receiver

The personality and other characteristics of the receiver of a message can affect persuasibility. A meta analysis by Rhodes and Wood (1992) supported the prediction that both very high and very low self-esteem individuals are harder to persuade. Low self-esteem individuals may lack attention or suffer anxiety, high self-esteem individuals tend not to yield from their position.

Susceptibility to persuasion increases until the age of 9 then decreases during adolescence and levels off. Females are generally more susceptible to persuasion than males (McGuire, 1969), although it is unknown whether recent research still supports this hypothesis. People in good moods are more sensitive to peripheral cues and do not process messages as well as individuals in neutral moods (Myers, 1990). A possible explanation for this finding was proposed by Mackie and Worth (1989). Good moods could cause positive thoughts which occupy memory capacity, thus leaving less memory to process the message. Alternatively, individuals in good moods may lack the motivation to process the message as fully (Bless, Bohner, Schwarz, & Strack, 1990).

Social support affects conformity to a persuasive message. Stroebe and Diehl (1981) found that individuals are more likely to comply with a message if other individuals also comply. Bickel and Repucci (1983, cited in Rogers, 1987) thought that the high drop-out rate of low income, high risk populations from health programmes was due to their social network which does not encourage self-protective behaviour.

Forewarning audiences forearms them against persuasive communication as it allows them to prepare counter-arguments. McGuire (1964) proposed a theory of inoculation to attitude change that is similar to inoculating someone against a disease. This can be achieved by exposing individuals to weak arguments that are against their attitudes. This will force them to come up with counter-arguments which will help protect them against further, more serious attacks on their attitudes. This can be aided by providing more supportive information and arguments supporting their attitudes. If a message is simple, it is possible to reduce counter-arguing by distracting the receiver.

If an individual has to defend or behave in a way that is discrepant from their own attitude, the amount of attitude change that occurs will increase as the rewards for displaying the discrepant attitude decrease. This is called the "insufficient justification principle" (Festinger & Carlsmith, 1959, cited in Myers, 1990). If subjects are well rewarded for a particular activity such as safe behaviour, then their attitudes do not need to change as the reward is sufficient justification for engaging in the behaviour. If the reward is small, there is insufficient justification for the behaviour so attitudes must favour the behaviour. A similar situation is when saying becomes believing. People who are encouraged to express a view they don't initially really believe will begin to believe what they say. If excessively bribed or forced this attitude change will not occur.

2.6 ATTITUDES AND BEHAVIOUR

Initially, social psychologists believed that by understanding an individual's attitudes their behaviour could be predicted. However, by the 1960s this reasoning was recognised as being too simplistic. Many studies demonstrated that a change in attitude often had little effect on behaviour. Wicker (1969) showed that expressed attitudes of a group usually predicted little of the variation in their behaviour. LaPiere (1934) also found a low correlation between attitudes and actions in a study of acceptance of Chinese guests in motels.

One reason for the poor relationship is that both behaviour and attitudes are affected by other social influences. Jones and Sigall (1971) tried to remove these influences by developing a "bogus pipeline" method for measuring attitudes. Subjects were led to believe that a machine could measure miniature muscular responses that indicated whether subjects wanted to turn a pointer left or right, indicating their agreement toward a statement. Their attitudes to a number of statements had been ascertained earlier. These questions were asked and the pointer turned the correct way. Once subjects were convinced that the machine worked, the pointer was hidden and subjects were asked questions concerning their attitudes towards American Blacks, and which way they thought the pointer turned. These subjects were more honest in their replies than the general population.

The effects of attitudes on behaviour are also more apparent if behaviour is examined over time, rather than as an isolated incident (Myers, 1990). Measuring attitudes specific to a behaviour are better at predicting behaviour than sampling general attitudes (an example of point-to-point correspondence). For example, attitudes towards "fitness" poorly predict specific exercise patterns; specific attitude questions about the benefits and costs of specific exercises would be a better predictor. To change people's health, Ajzen and Timko (1986) concluded that specific health-related attitudes should be targeted.

Making people self-conscious or asking them to think about their attitudes and past behaviour will increase attitude-behaviour consistency. Attitudes guide behaviour only when they come to mind, and so they need to be accessible (Kallgren & Wood, 1986). If attitudes are formed through direct experience, and not passively, they are stronger and more likely to predict behaviour. Fazio and Zanna (1981) found students that had to sleep in temporary beds in dormitory lounges, and students who still had rooms both displayed similar attitudes toward the shortage of beds. However, when it came to action, only those who were affected by the shortage joined committees and signed petitions.

Fishbein and Ajzen (1975) have developed one of the dominant theoretical frameworks with their theory of reasoned action. Attitudes and subjective norms combine to determine behavioural intentions that lead to volitional behaviours. This theory has successfully predicted behaviours in a number of areas such as seat belt use (Stasson & Fishbein, 1990). Criticisms of the theory however, include the finding that behavioural expectations are better predictors of behaviour than behavioural intentions. There is also debate over the role of external variables that are not always fully mediated by the attitudinal or normative components of the model (Olson & Zanna, 1993).

The theory of reasoned action has been elaborated by several researchers. Ajzen (1985) expanded the theory to create the theory of planned behaviour. This theory adds perceived behavioural control as a third predictor of intentions which is independent from attitudes and subjective norms. The MODE (*mo*tivation and *o*pportunity as *de*terminants of how attitudes influence behaviour) model proposed by Fazio (1990) also follows on from the theory of reasoned action. It emphasises motivation and opportunity as the determinants of how attitudes influence behaviour. If motivation or opportunities are not present, then only highly accessible attitudes will guide behaviour. Another new model is Eagly and Chaiken's (1992) composite model which examines both attitudes towards objects and attitudes towards behaviours.

Generally, people assume a change in attitude will lead to a change in behaviour but do not consider the reverse. However, behavioural effects on attitudes can be explained by the concepts of self-presentation, self-perception theory (Bem, 1972), and cognitive dissonance (Festinger, 1957). Self-presentation assumes that individuals express attitudes that make them appear consistent, as most individuals like to look good in front of others. Self-perception theory states that when individuals are unsure of their attitudes they infer them from examining their own behaviour (and seek consistency). Cognitive dissonance has been explained earlier in section 2.4.

Acting out a role (role playing) also appears to change attitudes toward the expected norm for that role. Lieberman (1956) observed workers before they were promoted to a union or foreman position. After the promotions, the promoted workers' attitudes changed over time. Workers promoted to foreman became more sympathetic to management positions while workers promoted to union positions became pro-union. This is hardly surprising as the workers were not merely acting out roles but were actually in them. Therefore they would be receiving persuasive arguments for their position. A better example of the power of role playing is the classic prison experiment conducted by Zimbardo (1972, cited in Myers, 1990). Subjects in

Zimbardo's experiment soon became caught up in the situation, which led to confusion between role playing and reality. Mann and Janis (1968) also found powerful effects of role playing. Young woman smokers who acted the role of lung cancer victims reduced smoking more than women who were given factual information.

2.7 ATTITUDE MEASUREMENT

Attitude research is only as good as the measurement technique used to gather information. Zimbardo and Ebbesen (1970) believe many of the conflicting results of attitude research were due to the use of various operational definitions and inconsistent methods of measurement. Past laboratory experiments in attitude research have suffered from the effects of experimenter, subject, and design bias. Research on methodology appears to have lagged behind theoretical issues (Kahle, 1984).

The most common technique for measuring attitudes is the global self-report that appears to concentrate on the affective or evaluative dimensions (likes and dislikes). There are many textbooks outlining recommendations on how to construct accurate attitude scales and questionnaires (Schmitt & Klimoski, 1991; Oppenheim, 1992). Numerous scales have been developed to measure specific concepts such as "locus of control" (for example: Rotter, 1966; Levenson,1981). In this field, researchers (Rotter, 1975; Lefcourt, 1982) have recommended that, for maximum prediction, locus of control measures be developed for specific populations and concerns rather than be created as general global measures. Lefcourt (1991) stated that even a specific four-item scale may prove more useful than an unrelated general scale.

Another approach involves the use of the psychophysical method developed by Thurstone (1928). This method is rather complex and also has its pitfalls. It assumes attitudes are arranged on a single continuum and that judgements of one population are applicable to another population. Despite the time required to create Thurstone scales, Likert (1932) demonstrated that simple a priori methods can achieve the same results. In a comparison of Likert and Thurstone methods, Edwards and Kenney (1946) found that Likert scales yield higher reliability coefficients and are less time-consuming so there does not appear to be much advantage in going through more complex procedures.

The quantitative measurement of attitudes has come under criticism by LaPiere (1934) who described questionnaires as a cheap, easy, and mechanical way of measuring highly complex human thoughts. Furthermore, questionnaires are often criticised for their lack of qualitative depth as they may find "x", but not shed light on why "x" occurred. They usually do not provide an adequate base for making causal inferences, and if all data is collected through a self-report questionnaire, results are more susceptible to response bias.

One of the greatest affects on responses to attitude questions is the way the questions are worded. Rasinski (1989) has shown that even minor variations in question wording can significantly affect responses. Response scales also provide a frame of reference for judgements to be made so these can affect the response. Question order and context have also been shown to have an affect on responses (Harrison & McLaughlin, 1993). Assimilation may occur when the previous questions activate information that is related to the current question thus causing responses to move in the same direction. Consider for example, the question "Are you satisfied with the safety in your job?" followed by "Are you satisfied with your job as a whole?". The contrast effect can occur in the opposite direction if the activated information serves as an anchor for judging the current question. This is illustrated by the questions "How would you rate the safety on the job ten years ago?" followed by "How would you rate the safety on your job now?"

Indirect, semi-projective techniques such as the incomplete sentence form, multi-dimensional scaling and free adjective descriptions, and the Own Categories Procedure have also been used to measure attitudes (Sherif & Sherif, 1964; Schroder, 1970; Edwards & Hahn, 1980). However, these techniques are time consuming, and the data collected is difficult to analyse and interpret.

The distinction between affect and evaluation in the structure of attitudes (Breckler & Wiggins, 1989; Zanna & Rempel, 1988 cited in Tesser & Shaffer, 1990), has implications for the measurement of attitudes. All aspects of attitudes can be represented in a variety of ways, for example, emotions may not be cognitively represented so may not be measured using the self-report questionnaire. New techniques are being developed but have not been used extensively. Bassili & Fletcher (1991) created a methodology for recording response times in telephone interviews. Others have examined physiological manifestations of thoughts and feelings through the use of facial EMG (slight muscle movements around the mouth and pupil dilation) in structured situations. These movements can reveal mental and attentional processes.

2.8 SUMMARY

Attitudes are very complex and difficult to understand due to their abstract nature. Unfortunately, the results of attitude research have often been in conflict and this makes it difficult to draw general conclusions. Despite these difficulties, attitude research has contributed a great amount to understanding human behaviour. Additional research needs to be devoted to understanding the relationship between attitudes and behaviour. Modern techniques incorporating both psychological and physiological measures may aid in this area.

CHAPTER 3 - ATTITUDES TOWARDS SAFETY

3.1 INTRODUCTION

Researchers have often studied attitudes towards safety in an attempt to improve safety either in society or specific work organisations. This research is based on the belief that negative attitudes result in, or are the cause of, accidents. Both absences from work and accidents have been found to be related to negative attitudes (Verhaegen, 1993). Early studies examined the concept of accident proneness, which reflects the idea that some individuals are more prone to have accidents due to their personal characteristics. Limitations with this concept has seen a shift to examining attributions in relation to accidents and how individuals view accidents. Concepts such as "locus of control", "severity dependent", and "self-other" attributions are now being applied to the field of safety.

Most studies examining safety attitudes have used workers as subjects. However, recent safety research (Griffiths, 1985; Dejoy, 1990) and accident causation models (Wagenaar, 1990) are now emphasising management attitudes towards safety as the key to lower accident rates. A good example of this emphasis is Dejoy's (1990) statement that "the attitudes and actions of management shape the safety climate of the organisation and can influence the safety performance of the entire work-force" (p.14).

The development of the concept "safety culture" (and the related concept of safety climate) also recognised the importance of management. Safety culture refers to the norms, beliefs, roles, and attitudes that a work organisation has towards safety (Pidgeon, 1991). Pidgeon believed that norms and rules (developed by management), both explicit and tacit are the key components that shape the perceptions of others. These perceptions of job safety and health are important concerns for many workers and this concern is increasing (Frenkel, Priest, & Ashford, 1980).

Despite the existence of many studies examining safety, Cox and Cox (1991) noted that there was little relevant theory on safety attitudes and its application in the workplace. Purdham (1984, cited in Cox & Cox, 1991) provided some theoretical guidance by dividing attitudes towards safety into four object areas. These areas are:

- Safety Hardware and Physical Hazards
- Safety Software and Concepts
- People
- Risk

Cox and Cox (1991) expanded this structure during an examination of attitudes towards safety software, risk, and people in a large European industrial gases company. Five factors appeared to describe attitudes towards safety: effectiveness of arrangements for safety, individual responsibility, personal scepticism, personal immunity, and the safeness of the work environment. Cox and Cox believed these groupings were consistent with Purdham's distinction between software, people, and risk.

This chapter describes the various safety attitude studies that have been conducted in each of the object areas identified by Purdham (1984, cited in Cox & Cox, 1991). Attribution theories that have been applied to safety, and models of accident causation are then discussed. Accident prevention campaigns are described and followed by a final section which focuses on safety research in the forest industry.

3.2 SAFETY HARDWARE AND PHYSICAL HAZARDS

Safety hardware refers to objects such as personal protective equipment (PPE), tools, and manufacturing equipment. Physical hazards include noise, heat, vibration, radiation, and dangerous chemicals (Cox & Cox, 1991). Numerous studies have examined attitudes towards these object areas with the resulting information being used to help redesign equipment, improve the workplace, and increase hazard awareness.

Personal Protective Equipment (PPE)

PPE ranges from level D, which is minimum protection (boots, gloves and overalls), to level A (self contained breathing apparatus and full protective body garment) (Dunbar, 1993). The aim of most studies of PPE has been to increase its usage. A study by Pirani and Reynolds (1976) found management opinions of why workers do not wear PPE were based on the view that workers were stupid, ignorant, or concerned about a "macho image". However, there was no evidence that non-wearing is mainly due to personal characteristics (Feeney, 1986). Many extrinsic factors such as poor functional design, discomfort, interference with the work task, nuisance value, and conflict with other demands are often cited reasons for the non-wearing of PPE.

The need to examine the effects of stress and working postures on worker comfort and PPE use was emphasised by Väyrynen and Ojanen (1993). A number of recent studies have demonstrated that wearing PPE can result in increased psychological and physiological stress. Dunbar (1993) found higher psychological stress scores were related to higher ratings of PPE discomfort and White, Hodous, and Vercruyssen (1989) found PPE usage resulted in increased cardiovascular stress. Some PPE (for example, visors) can also impair visual acuity and vigilance (Kobrick, Johnston, & McMenemy, 1990).

Dingus, Wreggit, and Hathaway (1993) examined the warning variables that affected PPE use. When confronted with a potentially serious injury, Dejoy (1989, cited in Dingus *et al.*, 1993) reported that more people read and complied with warning information. Dingus *et al.* demonstrated that warnings can dramatically and positively influence people under certain conditions. These results were similar to those found by Wogalter, Godfrey, Fontenelle, Desaulniers, Rothstein and Laughery (1987). The most important factor contributing to warning label effectiveness was the cost of compliance with warnings. "Cost" includes time, effort, discomfort, and expense of compliance to the PPE user.

Cost of compliance is not always the most important factor. Wogalter, Allison, and McKenna (1989) found peer pressure could override the effects of high cost of compliance. Adding information about the consequences of compliance or non-compliance in a place where the individual must interact with the warning can also increase compliance (Hathaway & Dingus, 1992).

Unrealistic attitudes toward the probability of an accident or its consequences is another possible reason for the non-wearing of PPE. These attitudes toward accident probability might change when wearing PPE. Despite Klen and Väyrynen's (1983) finding that PPE was rated as very effective by 1200 loggers, the majority of loggers claimed that they worked more carefully without PPE. This finding suggests that work behaviour may become more careless when PPE is used, as workers may feel less at risk. However, this suggestion was not supported by McCaig and Goodersen (1986) who found that PPE use was associated with increased risk perception.

Other possible reasons for not using PPE are conflict with the demands of production and peer pressure. Production pressure had a negative effect on Swedish forestry workers because safe behaviour had to compete with other production influences. Disregarding PPE regulations could increase the production of the workers (Sundström-Frisk, 1976). Peer pressure can reduce PPE usage as people often learn how to behave by watching the behaviour of their peers (modelling). To help overcome the negative effect of peer pressure, Ryckman (1990) suggested management should lead by example, provide positive incentives, and enforce usage.

The list of negative factors above demonstrate the difficulties that must be overcome to increase PPE usage. Zohar, Cohen, and Azar (1980) did a classic experiment on increasing the use of ear protectors in an organisation where management had tried group lectures, poster campaigns, and talks with individuals. All these methods had failed to significantly increase usage. Within a single department, Zohar *et al.* chose six workers randomly each day and gave them a hearing test both before and after work. The results, which highlighted the differences between those wearing and not wearing ear-plugs, were posted on the notice-board and given to the workers each day. Baseline observations of ear-plug use were made by an assistant safety officer. Unfortunately, double checks by researchers found these observations to be vastly inflated as the safety officer was trying to create a favourable impression. The experiment was carried out for one month and observation of usage continued for another six months. Ear-plug usage continued to increase with the experimental group, levelling off at 85-90% usage, despite an annual turnover rate of 65%. The control group remained at just 5% usage.

Physical Hazards and Environmental Conditions

Numerous studies have examined the effects of physical hazards such as noise and vibration. These environmental conditions can have an adverse effect on health, contributing to both stress and fatigue. As fatigue sets in, monitoring and attention capabilities deteriorate, risky acts increase, irritability rises, and options that require less effort are chosen (Hale & Glendon, 1987). Maintaining attention (vigilance) is becoming a serious problem in long-haul flight and railway operations (Cabon, Coblentz, Mollard, & Fouillot, 1993) and this loss of vigilance could contribute to an accident.

Bad physical work conditions are associated with workers feeling more unsafe (Rundmo, 1992a). Cold conditions can lead to clumsiness and decreased performance (Enander, 1984) and heat leads to sweating which can interfere with vision or grip. Noise can distract people from their task, while longer working hours have been associated with increased accident rates (Vernon, 1926, cited in Hale & Glendon, 1987).

Other studies concentrate on hazard identification and elimination. Parker and Kirk (1993) identified an average of 86 significant hazards that loggers were exposed to during delimbing, and another 31 hazards during felling. Inexperienced loggers exposed themselves to a larger number of hazards than experienced loggers, usually as a consequence of their poor work technique. Abeytunga (1978, cited in Hale & Glendon, 1987) noted that a common problem with removing some hazards is that they are considered as nobody's responsibility and are accepted as part of the job.

Frenkel *et al.* (1980) found workers who reported exposure to a greater number of hazards were less satisfied with their jobs. This decrease in job satisfaction could affect safety. Melamed, Luz, Najenson, Jucha, and Green (1989) discovered that job dissatisfaction was related to accident involvement and sickness absenteeism. However, neither of these studies demonstrate a causal relationship. Job dissatisfaction could be due to hazard exposure or accident involvement. Alternatively, being dissatisfied with a job may lead to increased hazard exposure, or another confounding variable may have contributed to these findings.

Melamed *et al.* (1989) also found that attitudes towards environmental conditions, in combination with an ergonomic stress level, were significantly correlated to accident involvement and sickness absence. As the ergonomic stress level increased (as measured by physical effort required, body posture, active hazards, and environmental conditions), accidents also increased. This is not surprising considering that active hazards were included in ergonomic stress level assessment. The interesting finding was that as the ergonomic stress level increased, workers who found the environmental conditions annoying (workers who were sensitive to the environmental conditions) were involved in more accidents than workers who did not find the conditions very annoying.

Person-Environment Fit theory has been applied to the field of safety. This theory emphasises the interaction between the person and their environment. With regards to safety, the theory hypothesizes that if individuals have a poor fit with their environment (mentally or physically) then they are more likely to suffer stress, and in turn, this stress may lead to the occurrence of more accidents. An experiment by Sherry (1991) supported this hypothesis suggesting that there is a relationship between individuals' attitudes towards the work environment and the occurrence of accidents. Furthermore, French, Caplan, and Van Harrison (1982, cited in Edwards & Van Harrison, 1993) found that a misfit between the person and the environment is associated with increased strain, including psychological disturbance.

3.3 SAFETY SOFTWARE AND CONCEPTS

Safety software and concepts refers to safety policies, rules, regulations, management factors, and concepts such as "accident proneness" (Cox & Cox, 1991). However, there appears to be some uncertainty as to what concepts should be classified under software. It can be argued that concepts such as "accident proneness" belong in the object area of people. In addition, concepts that have been classified in the object area of people by Cox and Cox (1991), could also be placed under safety software. For example, Cox and Cox classified the concept "personal scepticism" under the object area of people, yet some of the statements used in their research ("Safety works until we are busy" and "There is no point in reporting a near miss") appear to be related to safety arrangements, which Cox and Cox classified as safety software. As the statements used by Cox and Cox can be classified in both safety software and people, the distinctions between the object areas of safety are not entirely clear.

Studies of safety software have provided information for the implementation of successful safety programmes. Cohen, Smith, and Cohen (1975), Simonds and Shafai-Sahrai (1977), and Smith, Cohen, Cohen, and Cleveland (1978) have identified a number of factors that were correlated with successful company safety. A common factor is the need for top management involvement and commitment. Other factors that were identified included: low turnover, plant cleanliness, and a humanistic approach to dealing with employees.

Safety regulations were originally objected to by some members of the public as they invaded individual freedom. Safety rules were also subject to dispute, "work to rule" was recognised as a form of industrial action that was as disruptive as a strike (Hale & Glendon, 1987). Such actions made a mockery out of safety rules and regulations. However, it was recognised that some regulations were very effective. When legislation making seat-belt wearing compulsory was passed, seat-belt usage increased dramatically from near zero usage to almost 100% (Sutherland *et al.*, 1993).

Gun (1993) studied the role of safety regulations and their impact on the occurrence of injury. A total of 98 work-related injuries were investigated of which 53 were attributed to the violation of a regulation. Compliance with regulations was associated with management awareness and safety training. Walter and Haines (1988) found that workers lacked information on their legal rights, regulations, and effective strategies to improve safety. They suggested that workers might pursue safety matters more if their awareness of regulations was increased.

The concept of a "safety climate" has been around for over 20 years and is used to refer to the perceptions that people have of their work safety settings. These perceptions are developed as a frame of reference for appropriate behaviour (Dedobbeleer & Béland, 1991). "Climate" is also used by others to describe organisation attributes (James & Jones, 1974). In regards to safety, the climate is usually based upon individual perceptions.

On the basis of a literature review, Zohar (1980) identified eight factors that make up the safety climate. They are:

- Importance of safety training programmes
- Management attitudes towards safety.
- Effects of safe conduct on promotion.
- Level of risk at workplace
- Effects of required work pace on safety.
- Status of safety officer.

- Effects of safe conduct on social status
- Status of safety committee

The two most important determinants of the safety climate in Zohar's study were workers' perceptions of management attitudes about safety and the workers' perceptions regarding the relevance of safety in their work. Dedobbeleer and Béland (1991) also used a two factor model to describe the safety climate. These factors measured management commitment to safety in terms of their attitudes and practices, and worker involvement in safety.

Brown and Holmes (1986) found three determinants of the safety climate: perception of how concerned management is with worker well-being, perception of how active management is in responding to this concern, and employee physical risk perceptions.

A common factor in all models is the important role of management. Zohar (1980) concluded that "a genuine change in management attitudes and increased commitment are prerequisites for any successful attempt at improving the safety level in industrial organisations" (p.101).

3.4 PEOPLE

Many studies have focused on people as the objects of attitudes. The people may include the safety specialist, inspector, management, supervisors, and workers (Cox & Cox, 1991). In the previous section, the difficulties in distinguishing between software and people were noted. Further difficulties arise when examining what safety attitudes belong under the object area of people. In their study, Cox and Cox (1991) placed "responsibility" under people. Two of the statements in this category were attitudes towards individuals, or "oneself". However, a statement not related toward any particular person or group, namely "Safety equipment should always be worn", was also included. This statement reflects an attitude towards personal protective equipment. It seems fair to include such a statement under "responsibility", but it does not conform to the definition of people as an object area. This problem is difficult to reconcile.

Understanding the attitudes of people aids in the development of safety programmes. DeBobes (1986) stated that attitudes of the individual must be considered when developing safety programmes. Weinstein (1987) noted that only a few safety programmes tailor their message to the characteristics of their audience. They often ignore "such basic issues as the norms and values of the audience, its beliefs about the hazard and the precaution, its reading level, and its financial resources" (p.333).

Studying attitudes provides an insight into psychological factors that may be contributing to accidents. Guastello (1991) found injuries occurred to transit operators who experienced stress and anxiety. In a study aimed at increasing the use of motorcycle safety helmets, Allegrante *et al.* (1980) found the decision to use a safety helmet was primarily under attitudinal control. Those who wore helmets differed from those that did not in their belief of the safety and comfort-convenience of helmets. Both these studies enable safety programmes to address the problems identified.

The subjects in the majority of safety studies have been workers because of the widespread tendency to view the worker as being the cause of accidents. The recent emphasis on the importance of management attitudes (Zohar, 1980; Brown & Holmes, 1986; Dedobbeleer & Béland, 1991) and decisions (Dejoy, 1990; Wagenaar, Hudson, & Reason, 1990), is now shifting the focus of studies. Inferences made by top management about the reasons for safety performance can have a major impact on the safety climate of an organisation (Dejoy, 1985). This has caused new methods to be developed to assess the effect management has on safety, such as Whalley and Lihou's (1988) management oversight risk trees (MORT) and statement analysis methods.

Supervisors also play an important role in regards to safety (Heinrich, 1931; Hale & Glendon, 1987; Weber, 1992). Studies have showed that there is a link between safety performance and the attitudes of supervisors (Simonds & Shafai-Sahrai, 1977; Eyssen, Hoffmann, & Spengler, 1980). Dejoy (1990) states "the safety attitudes of the first-line supervisor can have a significant positive or negative effect on the safety level of the work group" (p.14). This effect was demonstrated by Kimeyer and Dougherty (1988) who found that under high work loads, supervisor support encouraged coping behaviours.

Other factors such as the size of work groups, and the influence of social groups can affect safe behaviour. In work units of 15 or more people, Guastello and Guastello (1987) found only high accident rates occurred. They suggested that the effects of group cohesion, closeness of supervision, and the division of labour in small work units were possible explanations for this result.

Suchman (1965) provided some evidence that social groups are more important determinants of healthy behaviour among those in the working class, than in the professional class. Age may also affect susceptibility to social influence. Clark and Prolisko (1979) found young drivers with accident records were less open to social influence and less concerned about social rules than a matched accident free group.

Many studies still attempt to identify individuals who are "accident prone" or have poor attitudes towards safety. Boye, Slora, and Britton (1990) tested an employee safety attitude inventory and found it to be a reliable method of identifying individuals at higher risk for work-related accidents. Stinnett (1990) emphasised individual traits such as accident proneness as a cause of many accidents. Problems with these studies are discussed in the section on accident causation. It should be noted that such techniques have not been very successful at preventing accidents (Guastello, 1993).

3.5 RISK

Risk, or more precisely, risk perception, has been the most extensively researched attitude area in regards to safety. This is due to the commonly held belief that individual risk acceptance is a major factor in accident causation (Dunn, 1972a). The main purpose of many safety programmes is generally to increase risk perception and hazard awareness. It is assumed that increasing risk perceptions will cause individuals to be more careful, and as a consequence, have less accidents. For example, Griffeth and Rogers (1978) found increased perceptions of risk or severity could improve driving performance.

Three areas of risk that have been extensively studied are risk homoeostasis theory, subjective risk appraisals versus objective risk data, and risk communication. Each of these areas is discussed and critically evaluated below.

Risk Homoeostasis Theory

The theory of risk homoeostasis (also spelt "homeostasis" by many researchers) was proposed by Wilde (1982) to explain why some improvements in safety equipment do not result in less accidents. Risk homoeostasis theory (RHT) states that people adjust their behaviour to changing circumstances so that the objective risk remains relatively constant. For example, the introduction of studded tyres to improve grip in icy conditions was negated by driving faster (Rumar, Berggrund, Jernberg, Ytterborn, 1976). The studded tyres reduced the objective risk and, as a consequence, people drove faster to bring the objective risk back to its previous level.

According to RHT, accident rates on the road per kilometre may decrease, but per hour or capita they will remain constant unless accompanied by motivational measures aimed at reducing the level of acceptable risk (Wilde, 1984). Howarth (1987) stated that there is overwhelming evidence that people will adapt to an increase in perceived risk by taking more care, and if perceived risk decreases, they will take less care. To improve safe behaviour, the objective risk needs to be minimised while maximising the subjective risk.

This theory, if true, has serious implications as it suggests that investments in time and money in safety programmes and ergonomics may be wasted. However, McKenna (1982; 1985; 1987) refutes RHT and questions several assumptions of the theory. These assumptions are:

(1) People have a simple and straight forward representation of accident risk.
(2) People can detect all changes in this accident risk.
(3) People can, over time, completely compensate for changes in this accident risk.
(4) People cannot be discouraged or prevented from compensating for changes in accident risk.

Studies of subjective risk estimates and actual objective risk data suggest that people do not have an accurate or stable risk perception (see following section). Secondly, people cannot accurately assess changes in risk associated with improved design (such as improved steering columns and energy absorbing crash barriers), as they are non-visible. McKenna (1987) believes people cannot always successfully compensate for safety measures as studies have found improved design results in better safety (Wilson & Anderson, 1980; Hakkert, Zaidel, & Sarelle, 1981; Evans, Wasielewski, & Von Buseck, 1982), so the third assumption is false.

McKenna also questions the validity of studies cited as evidence for RHT. For instance, despite drivers in Rumar *et al.'s* (1976) study driving faster with studded tyres, they still had a larger safety margin. The final assumption is also invalid because there are successful methods to discourage people compensating for improvements as mentioned earlier. In conclusion, McKenna (1987) stated that risk homoeostasis theory has little supporting evidence.

Wilde (1988) answered McKenna's objections by restating the assumptions of RHT. Although originally proposed at the individual level, Wilde stated that the effect is at a population level, so "shift in risk" can occur. This means that the theory is supported as long as the risk for the population or society remains the same, rather than for the individual. So if a car can go faster with a decreased risk for the driver, there will be an increased risk elsewhere, i.e. for the pedestrians.

Adams (1988) believed that safety improvements that were psychologically invisible (such as shock absorbing crash barriers) have little relevance to RHT as there is not enough evidence supporting their long-term effects on safety. Once people become aware of these improvements they will then compensate for them. Furthermore, RHT does not state that safety improvements will always be compensated for by changes in behaviour. If there are no benefits for compensating behaviour then it will not occur (Wilde, 1988).

These changes in assumptions have led to further criticisms. It has been argued that RHT is not a valid theory because it is not testable. Wilde has not specified the evidence required to falsify the theory (Hoyes & Glendon, 1993). There is also the problem of bi-directionality. If behaviour compensates for safety improvements then behaviour should also compensate for conditions where safety is worse. Yet drivers have more accidents in the wet suggesting that they compensate very little when safety is worse. Wilde (1989) explained this finding by stating that only a subset of the population may venture out in the wet, those with higher risk acceptability levels. However, no studies were cited to support this.

If behavioural compensation only occurs to bring direct benefits, then this will explain why compensation does not occur in conditions where safety is worse. But if behaviour only occurs to bring direct benefits, then people do not keep their objective risk level, or the populations, constant. Therefore the original assumption of RHT that people adjust their behaviour to keep objective risk constant is invalid.

Subjective and Objective Risk

Individual perception of risk has often been associated with accident causation (Symes, 1993). Sell (1964, cited in Dunn, 1972a) suggested that accidents are most likely to occur when people think that the risk of an accident is lower than an actual objective measure of risk would indicate. A number of studies have been conducted that examine this hypothesis. These are described below.

Dunn (1972a) measured the subjective risk estimates made by 25 chain-saw operators (loggers) and compared these estimates with an objective risk distribution from reported accidents. Dunn believed that if there was agreement between the two measures, then as long as the decision criteria were valid, good decisions will be made. If a mis-match occurs, then decisions will be poor and cause an increase in accident probability. Loggers ranked which part of the body was most likely to be injured during different logging tasks, their rankings were not significantly correlated to objective rankings.

Powell (1972) criticised Dunn's study for the use of accident reports as objective data. The problem of under reporting would cause accident reports to differ from the actual number of accidents occurring. Dunn (1972b) answered Powell's criticism by citing a study that demonstrated that the distribution of reported accidents and critical incidents that occurred were very similar.

Ostberg (1980) studied the risk perception of 731 forestry personnel, including 393 fellers and found that they had an accurate perception of risk in typical felling situations. Supervisors generally underestimated the risks in comparison to the workers. Klen (1988) found loggers' subjective estimates of risk to be roughly similar to objective accident data, although there was an overestimation of serious accidents. Loggers also reported being more careful after a near-miss and less careful when wearing personal protective equipment.

In New Zealand, Tapp *et al.* (1990) asked loggers to rate the chance of being injured in various jobs using a 5-point Likert scale. They concluded that loggers were well aware of the risks as the subjective rankings matched the objective data of the Logging Industry Accident Reporting Scheme (ARS).

A problem with the studies above is that none actually measure what they propose, namely, subjective risk estimates of having an accident. Dunn (1972a) and Ostberg (1980) both asked loggers to rate which tasks are riskier than other tasks. Loggers may be aware that felling is riskier than skid-work, but are they aware of the likelihood of being injured if felling for one year? Tapp *et al.* used a Likert scale from 1 = low chance to 5 = high chance, but does high chance equal 1/1000, 1/100, or 1/10. The conventional procedure to determine risk involves multiplying the probability of a risk with its severity (Hansson, 1989). Surely, if subjective estimates do affect behaviour, it would be these estimates of likelihood and severity that are important, rather than general comparisons.

Risk studies often fail to take into account the severity of injury that may occur in a particular task. If a particular task results in a small number of very severe injuries, then is this task more or less risky than another task that results in twice as many injuries of lesser severity? Studies suggest that injury severity may have a greater influence on risk perception than likelihood of injury. Rundmo (1992b) found personnel on offshore petroleum platforms most frequently perceived risk with major accidents and disasters, despite such events being very infrequent. Rundmo suggested that this could be because workers fear the severe consequences of an accident rather than its probability. Alternatively, they may fear the lack of control over such events.

Wogalter, Brems, and Martin (1993) noted that lay person estimates of risk are not pure measures of likelihood, they are also influenced by the severity or consequences of the risk. Hansson (1989) stated there are several dimensions of risk to consider when making risk comparisons. They include:

- The character of the negative consequences.
- The magnitude of consequences.

- The distribution of consequences in the population.
- The time factor.
- Whether risks are new or old.
- Probability of negative consequences.
- Probability of being able to avoid the negative consequences.
- The knowledge of risks.

Slovic (1987) also noted how an individual's attitudes and perceptions of risks are influenced by many other factors including those of a sociological nature (for example, the social influence of friends). The high number and complexity of these factors demonstrate the difficulty of making risk decisions, comparisons, and evaluations. For example, in Tapp *et al.* 's (1990) study, loggers may be influenced by factors outside their own job when ranking the risk associated with fatalities. Although the risk of death in logging may be lower than many other injuries being rated, the risk of death in logging is very high when compared to other occupations. This may increase the rankings of risk associated with fatalities.

The use of questionable objective data is also a problem in risk perception studies. Tapp *et al.* (1990) stated that loggers rated the risk associated with landing work and breaking out similarly. This was compared to objective data obtained from the Accident Reporting Scheme (ARS) which showed that landing work accounted for 21% of accidents in 1988 while breaking-out only accounted for 12% (Gaskin, 1989). On this basis, Tapp *et al.* (1990) and Gaskin and Parker (1993) suggested that loggers estimates of risk were wrong. However, the accident statistics presented in the format of the ARS do not provide useful data for objective risk measures. The number of loggers breaking-out is far smaller than the number doing skid-work, so breaking-out could actually be more risky than skid-work. Therefore, loggers estimates of risks might be correct. Accidents need to be expressed as a rate, either in terms of hours exposed, number injured per year over the number doing the job, or probability of an injury in a year, before the objective data can be of much use.

The assumption that perceptions of risk influence behaviour has been questioned by Howarth (1988). In a study of drivers' subjective estimates of risks involving accidents with child pedestrians, Howarth found that subjective estimates were very high in comparison with the objective risk, yet behaviour was closely associated with objective risk. Howarth argued that if behaviour is well practised it does not require conscious effort. As a consequence, risk perceptions which require conscious effort do not affect behaviour.

There are a number of reasons why people may have inaccurate perceptions of risk. Mechitov and Rebrik (1990) noted that the form of the question, mass media, and knowledge of risks affects risk assessments. In an examination of consumers' risk perceptions of commonly used products, Wogalter *et al.* (1993) found quick estimates of risk were just as accurate as risk estimates following more careful analysis of accident scenarios. This suggests that knowledge of risk may be through personal experience or based upon the examination of just one related accident scenario.

Although people may weigh the potential costs of taking a precaution against the benefits that may be received (Weinstein, 1987), Saari (1990) noted that people are not completely rational and are influenced by feelings in decision making. People are limited in their ability to process information, especially when the risks and outcomes are all uncertainties (Slovic, Fischhoff, & Lichtenstein, 1987). Personal experience of an accident resulting in injury is rare. Due to this, protective action is unattractive as it often requires an investment in time and money for a future benefit that may never occur. This reasoning may strengthen with work experience. Each time protective action is not taken and no injury occurs, the unsafe behaviour has been reinforced.

A great deal of research has been devoted to risk assessment and perceived likelihood. Hale and Glendon (1987) reviewed the risk literature and concluded that people were consistently bad at estimating risks. Further studies show that people are overly optimistic about the risks of their own psychological attributes and actions (Weinstein, 1984). People believe that they can control these attributes thus decreasing their own risk. For example, Svenson (1981) discovered drivers had the tendency to rate themselves as more skilful and less risky than other drivers, and O'Hare (1990) found pilots generally had a low level of risk awareness and an optimistic self appraisal of their own abilities. Weinstein and Lachendro (1982) suggest that people are egocentric when making risk judgements. They give themselves credit for factors that reduce their own risk, but do not stop to consider that other people may also have these factors, or more factors that assist them.

It should not be surprising that people are bad at rating their own personal probability of being involved in an accident. They know they are different from others, have gone through different experiences, and that the future can be different from the past. To be aware of the risk associated with all illnesses and accidents could lead to anxiety. At present, risk perception is not correlated to general anxiety (Sjöberg & Drottz-Sjöberg, 1991), however this may change if risk perceptions were accurate.

Risk Communication

Risk communication follows many of the principles of general attitude persuasion discussed in Chapter 2. Holmes (1993) has argued that risk communication based upon technical risk assessments are not widely believed or accepted by the public. Many safety programmes have tried to address this by educating the public about their mis-perceptions and persuading them to accept certain facts. This form of risk communication does not reduce conflict nor solve uncertainty. Holmes suggests that campaigns need to integrate social aspects and the lay person's view, if these conflicts are to be resolved. People are influenced by social feedback, so safety programmes should be complemented with motivation-oriented programmes (Saari, 1990). The importance of social feedback was demonstrated by Goldberg, Dariel, and Rubin (1991) who used co-worker support to move workers towards participation in safety, rather than having a fatalistic acceptance when reacting to a perception of threat.

Fischer, Morgan, Fischhoff, Nair and Lave (1991) found people attach the greatest priority to risks that they feel responsible for and efficacious. They are more likely to take action on these risks, especially if they have information on how to take effective action.

Communicating risks does not appear to be a very effective means of increasing PPE usage. Schneifer *et al.* (1974, cited in Saari, 1990) examined the effects of training a group of workers on the risks associated with not wearing safety goggles. A second group was just shown slides of workers wearing safety goggles. The first group only increased goggle use by 2% while the second group increased usage by 10%. Averill (1987) argued that risk communication often fails because it does not arouse fear. Risks are uncertainties, the probabilities are often small, and the threat is located at some unknown time in the future. As a consequence, the arousal of fear is very minor, thus it does not provide motivation for safe behaviour.

Knowledge of risks is not always enough to bring about safe behaviour. Saari (1990) noted that people do not necessarily want to avoid risks as they expect challenges from their jobs and it is often the risk factor that provides this. Allen (1981, cited in Hale & Glendon, 1987) noted that greater danger is associated with friendliness, shared feelings, and a sense of purpose. Risk adds excitement to life which is why certain activities are designed to increase feelings of risk, for example, bungy jumping.

To change perceptions of risk, safety measures should be directed at improving physical and organisational working conditions, rather than trying to communicate risk. Safety and contingency aspects exert a strong influence on risk perception, as the more satisfied people are with these aspects, the less injuries they experience (Rundmo, 1992a). Risk communication in the past may have focused on the wrong audience. Wagenaar (1990) emphasised that risk communication should be aimed at managers as this is where the decision making processes that can create (or remove) risks occur.

3. 6 ATTRIBUTION THEORIES

Attribution theory is concerned with how people attribute causes to events. The theory assumes that an individual's perceptions of causality are important determinants of subsequent behaviour. When applied to safety, attribution theory can be viewed as attitudes towards accident causes. Understanding the biases present in attribution sheds light on why early theories of accident causation are still very popular, despite limited empirical support.

Hurry (1985, cited in Hale & Glendon, 1987) argued that attribution theory cannot legitimately be applied to accidents as they are unintended events. However, controllability is an important dimension of attribution (Russell, 1982). If people think an event is due to chance, their behaviour is likely to be different than if they thought they had control over the event.

Two other important dimensions identified by Russell (1982) were stability and locus of control. People look for patterns or features common in all events to provide stability. If some object or person is involved in several events, cause will be attributed to that stable element. The third dimension, locus of control is discussed in detail below.

Locus of Control

Locus of control originated from Rotter's social learning theory and refers to an internal state that explains why some people will make an effort to overcome difficulties while others let the difficulties defeat them. The concept connects personal characteristics and actions with experienced outcomes. This is achieved through the role of reinforcement. People react differently when actions are reinforced. One of the determinants of this reaction is whether the reinforcement (or reward) is perceived to follow from their behaviour (internal locus of control), or if it is controlled by other factors that are independent from their own actions (external locus of control) (Rotter, 1966). These perceptions of control can be examined as a situational dependent factor, or as a personality dimension.

Individuals with an external locus of control (externals) are more likely to attribute outcomes and experiences to luck or other external factors that are outside their control. Externals have been found to be more depressed, anxious and less able to cope with stress than internals. Research by James and Wright (1993) found external locus of control was positively related to levels of stress in the ambulance service and Lester and Pitts (1990) found depression in police officers was positively correlated to external locus of control.

Individuals with an internal locus of control (internals) are more likely to attribute experiences to their own actions. They believe that outcomes are contingent on their actions. Internals are more goal and information seeking, alert, autonomous decision makers, and have a greater sense of well-being. Internals are also more likely to attempt to control a situation and seek out information about a problem; externals are more likely to attempt to get social action started (Joe, 1971).

Unfortunately, it can be argued either way that internals or externals will engage in greater safe behaviour. Internals should be more prepared to engage in safe behaviour because they believe they can control the risk of accidents so will act to avoid it, or, they may regard themselves in control of the whole situation and so believe that they will not have an accident. A number of studies have demonstrated that those who believe they have control over dangerous situations show little fear or concern (Hale & Glendon, 1987). Joe (1971) found that if internals believed they were in control of a situation, they were more prepared to take risks. Abeytunga (1978, cited in Hale & Glendon, 1987) found supervisors who believed hazards were under the control of skilled craftsman did not personally concern themselves with the hazard.

Externals may regard accidents as outside their control so do nothing at all, or, take all the action they can, such as wear protective gear, as they cannot control their involvement in accidents. Jones and Wuebker (1988) found employees involved in accidents tended to be "external" in control and tended to blame management for their mishaps.

Despite these mixed findings, it appears preferable to have an internal locus of control. Eyssen *et al.* (1980) found a clear link between managers' belief that the safety was controllable and low accident rates. Jobs which do not offer workers a sense of control are perceived as "risky" and heighten anxiety (Shouksmith, 1990). In an examination of attitudes towards safety in construction work, Leather (1988) investigated the differences between the public and private sector. Workers in the private sector believed they had more control over their own destiny. Public sector workers felt more constrained and under pressure due to the influence of bonuses. There has been some research that does suggest bonus payments are associated with less safe work practices (Wrench 1972, cited in Leather, 1988).

Although internal locus of control appears preferable, people need to be aware of illusions of over control. Rantanen (1981, cited in Hale & Glendon, 1987) suggested that the more opportunity people have to experience hazards, the more control they feel they have over the hazards. This may explain why people have illusions of control with regards to road safety (Svenson, 1978) as they experience the hazards frequently without incident.

Attribution Biases

Self-other attribution biases can seriously affect accident investigations and safety as a whole (Dejoy, 1985). An example of self-other attributional bias is the "Fundamental Attribution Error" (Ross, 1977). This term is used to describe the tendency of observers to underestimate situational influences and overestimate dispositional influences when describing the behaviour of others. This attributional error has been demonstrated in many situations. When college students were presented with accounts of car accidents, Brickman, Ryan, and Wortman (1975) found that students placed greater value on the internal factors of the person, rather than the external situation.

A closely related concept to the fundamental attribution error is Shaver's (1970) defensive attribution hypothesis which states that victims or eyewitnesses will tend to explain accidents in a way that minimises personal responsibility. Salminen (1992) found results supporting this hypothesis: victims attributed accidents to external factors while co-workers and foremen attributed accidents to internal factors. Other studies that have examined self-other attribution processes have found that supervisors attribute more importance to internal causes when examining accidents (Lacroix & Dejoy, 1989).

More responsibility is assigned to the people involved in an accident when the consequences are severe (Chaikin & Darley, 1973). This tendency is called the severity-dependent attribution. If the situation is relevant to the observer, and personal similarity to those involved in the accident is low, more responsibility is likely to be attributed to those involved in the accident. In a meta-analysis of the defensive and severity-dependent attribution hypotheses using 22 studies, Burger (1981) found a weak but significant relationship for the tendency of observers attributing more responsibility to accident perpetrators in serious accidents, except if the perpetrators were similar to the observer. A possible explanation for this severity-dependent effect is that mild accidents happen all the time, so they do not appear to be the result of any specific individual act. Severe accidents are more infrequent, so the observer may associate the event with the people involved.

These errors in attribution may serve self-protective or self-serving biases, which tend to make people accept responsibility for success but deny responsibility for failure. Individuals generally believe they are less at risk than the average person (McKenna, Stanier, & Lewis, 1991; Guppy, 1993). By blaming the victim, observers can believe that they can avoid the same accident in the same situation (Walster, 1966; McKillip & Posavalo, 1974). While the self-blame of many accident victims does go against the defensive attribution hypothesis, it still serves a self-protective function. By blaming themselves, victims can believe that the same accident is avoidable in the future.

Brown (1984) argued that upper management will show stronger biases towards internal attributions because they are removed from the work situation, they are likely to have little experience performing workers jobs, and they are likely to compare groups of workers so if one group is performing poorly it will be attributed to their internal factors. If managers or supervisors attributions are biased, then remedies to prevent future accidents may be inappropriate, resulting in ineffective programmes and increased organisational conflict (Dejoy, 1985). Dejoy (1985) also stated that successful safety programmes are found where a pronounced bias toward internal attribution does not exist.

3.7 ACCIDENT CAUSATION

Accident Proneness

The idea that individuals may have personality traits that predispose them to accidents was introduced by Greenwood, Woods and Yule (1919, cited in Oborne, 1987). During their study of accidents at a munitions factory, a small minority of workers had more accidents than what would be explained by chance alone. Farmer and Chambers (1939) proposed that accident proneness was a personality trait, with some people being more careless than others. In contrast, Reason (1974, cited in Oborne, 1987) suggested that accident proneness may be a phase that people pass through, such as young drivers having more accidents.

One of the personality traits that was thought to predispose individuals to accidents was attitudes. It was assumed that accident prone people may have poor attitudes towards safety. However, Murphy (1981) found 493 farmers had very similar attitudes towards safety, regardless of their accident involvement. Murphy then questioned the high priority given to safety attitude development as a means of accident prevention. Sutherland *et al.* (1993) also noted problems with safety programmes concentrating on attitudes, because the attitude-behaviour relationship can be weak. They emphasised behavioural modification approaches to improving safety which appear to be more effective.

Hale and Glendon (1987) note how the concept of accident proneness became very popular, even without valid empirical support. There have been many criticisms of accident proneness studies. Perhaps the most crucial is that the studies do not take account of the hazards faced by different groups of workers. Just because forest workers have more accidents than bank tellers does not mean they are accident prone.

Despite these criticisms, the idea that certain individuals are accident prone is still promoted by many researchers. Stinnett (1990) stated that accidents are committed by people who are not aware, and characteristics such as: accident proneness, stupidity, and compulsiveness are primary causes of accidents. Boye *et al.* (1990) tested a safety attitude inventory and believed it to be a reliable method of identifying individuals at higher risk of accidents. Hansen (1989) developed a causal model demonstrating that social maladjustment and distractibility scores were significant causal parameters of accidents. Other personality traits have also been studied in relation to accident proneness. Drivers that scored higher on the extrovert scale had more accidents and violations than introverts (Fine, 1963, cited in Oborne, 1987). Obviously there is still a long way to go to remove the idea of individual characteristics as the primary cause of accidents.

The Domino Theory

The domino theory (Heinrich, 1941) viewed individual and environmental factors in isolation. Heinrich believed that an individual's ancestry can endow them with some undesirable traits such as "recklessness", which can be developed further by environmental factors. This leads to faults in a person that are proximate reasons for committing "unsafe acts" or the existence of physical hazards. The "unsafe acts" in combination with physical hazards lead to accidents which, in turn, can lead to injuries. To prevent accidents, Heinrich believed that "unsafe acts" and "unsafe conditions" need to be targeted. These terms (unsafe act and unsafe condition) are still used today, however this theory also places too much emphasis on the individual.

Modern Theories of Accident Causation

Advances in attribution theory can been seen in current accident causation models which have moved away from placing blame on the individual. Wigglesworth (1972) introduced the term "non-culpable error" which can be defined objectively, whereas "unsafe act" is more subjective and judgmental. Non-culpable error places no blame on any individual for errors which are defined objectively as missing or inappropriate responses.

Dejoy (1990) proposed a model that emphasises person, task and environmental variables that together can create error provocative situations. Dejoy believed that many models over-simplify human error and underestimate the importance of task and environmental variables. Predisposing factors that can affect decision making in Dejoy's model include: attitudes, beliefs and perceptions. These factors influence whether a person will engage in self-protective behaviour.

Wagenaar *et al.* (1990) believe errors in cognitive functioning are the most common causes of accidents, and the most dangerous. Their model is displayed in Figure 1 as it emphasises both the role of psychological and management factors. Starting at the right end of the model, the black line represents defence mechanisms that stop unsafe acts leading to accidents. Defences are generally engineering designs aimed at making systems as safe as possible. However, some accidents do occur so there must be holes in these mechanisms. The unsafe acts that lead to accidents are not random events. Their origins lie in psychological states of mind or patterns or reasoning which are called psychological precursors.

Psychological precursors answer the question "Why did you do it". The answers can be explained in terms of the physical and organisational environment and are called "general failure types". General failure types that promote the psychological precursors are the physical environment (design failures, missing defences, hardware defects, negligent housekeeping, error-enforcing conditions), human behaviour (poor procedures, defective training), and management (organisational failures, incompatible goals, lack of communication). These failure types can be created or removed through management decisions. They are usually latent, lying dormant until an active failure triggers them off.

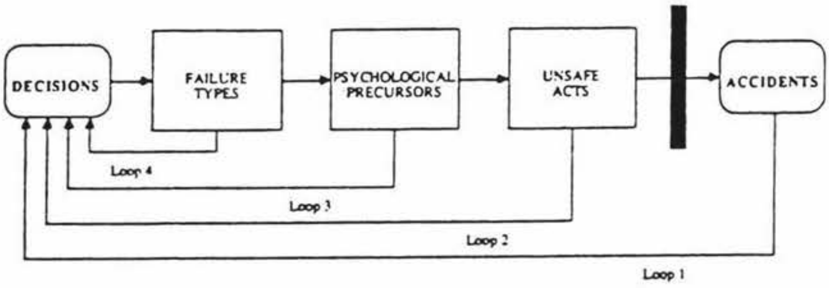


Figure 1. General accident scenario (Wagenaar *et al.* , 1990)

To discuss psychological precursors, Wagenaar *et al.* (1990) used Rasmussen's (1982) three level theory and Norman's (1981) distinction between slips and mistakes. Slips are errors made in the execution of the perfect plan. Mistakes are the perfect execution of the wrong plan, errors are not found until the end result.

Rasmussen (1982) stated that there were three levels of control of human behaviour, these are skills, rules and knowledge. Behaviour can be automatic when skills are well learned, only basic checks are required. If the checks are satisfactory, control remains in the skill level. If a discrepancy is found, control moves to the rule-based level. If the problem is recognised, "if-then" rules will be applied. If the "if-then" rules are successful, control moves back to the skill-based level. If not, or rules are unknown, control moves to the knowledge-based level. Here a problem is fully analysed and original solutions are sought.

Slips can occur at the skill-based level while serious mistakes occur at the rule-based level. Serious mistakes are not discovered until something goes wrong. Other mistakes occur at the knowledge level, however these are usually discovered before the end result.

The four feedback loops in Figure 1 show how management receives feedback on their decisions. Loop one presents accident statistics, so the accident has already occurred. Loop two provides information about unsafe acts that have been observed, however many of these actions cannot be recognised in advance. The third loop only provides information if a thorough examination of the work conditions takes place. Wagenaar *et al.* believed it was unlikely that the examinations could be done often enough to provide useful information. Loop four would provide the most useful information with the shortest delay. Unfortunately, there are no established methods currently available to detect general failure types.

Wagenaar (1990) stated that in most accident scenarios, participants thought they were in a routine situation so their normal habits applied. Wagenaar and Groeneweg (1987) found an average of 32 building blocks (contributing factors) per sea accident that were spread both geographically and in time. No single person could have known all the factors until after the event, emphasising that individual traits are unlikely to be the sole cause of accidents.

3.8 SAFETY PROMOTION AND ACCIDENT PREVENTION

A vast quantity of literature exists on possible methods and actions that can improve safety and prevent accidents (Aherin, Murphy, & Westaby, 1990). Educational programmes, although very common, often have little effect on safety-related behaviour (Weinstein, 1987). Howarth (1988) believed educational programmes aimed at changing risk perceptions will not affect safety-related behaviour, as most behaviour does not require conscious effort. Current safety programmes now tend to emphasise the behavioural approach to changing behaviour (Krause *et al.*, 1984; Bellamy, 1991; Sutherland *et al.*, 1993), and the importance of total quality management (Mitchell, 1993; Smith, 1993).

In a review of various safety programmes, Guastello (1993) found that personnel selection programmes that try to identify accident prone people were not very effective. Near-miss accident reporting did not decrease accident frequency, but did result in a 56% decrease in accident severity in one company. The effectiveness of the International Safety Rating System (ISRS) varied, with some companies achieving a 22% decrease in accidents while other ISRS programmes resulted in no change.

Poster campaigns also varied in their success, from 0 to 33%. Pirani and Reynolds (1976) showed that posters and films can result in increased safety performance. Personal protective equipment (PPE) posters resulted in a 51% increase in PPE usage over two weeks but this fell to 11% after 4 months. In a review of a large number of poster campaigns, Sell (1977) found that most effects were short lived with behaviour reverting back to baseline levels after 4 to 6 months. Campaigns with specific messages targeting specific behaviour tend to be more effective with lasting effects (Griep, 1970; Laner & Sell, 1960).

For physically demanding jobs, exercise programmes can be effective in reducing strain injuries. Firefighters' injuries were reduced by 16% through an exercise programme. Although this is a significant reduction, Guastello (1993) found the most successful methods to reduce accidents were:

- Comprehensive ergonomics.
- Technological interventions.
- Behavioural modification programmes.

Comprehensive ergonomics is "comprehensive" because it includes a whole range of activities that require management commitment, worker involvement, and emphasis on the concept of a "safety climate". These activities include safe performance monitoring, hazard control, work groups, supervisors with more accountability for safety, as well as improved ergonomic design. The average reduction in accident frequency was 50% with such programmes (Guastello, 1993).

Technological interventions use robotics and facility redesign to remove hazards and eliminate human error, but these are relatively expensive. Over four studies, the average reduction in accidents was 29%.

Behavioural modification attempts to change behaviour through extensive training in proper safe behaviour. This is followed by periods of observation and feedback. Programmes often include goal setting and forms of reinforcement (or incentives). Goal setting alone improves safety performance (Reber, Wallin, & Chhokar, 1990), and adding feedback to the goal setting process improved performance even more. Incentives should be directed at safe behaviour, not accidents as this leads to non-reporting. Guastello (1993) reported that behavioural modification has decreased accident frequency by 12 to 94%. These programmes that target behaviour, rather than attitudes, are also more cost-effective (Geller, 1986).

Some researchers (Klein & Waller, 1970, cited in Murphy, 1981; Weinstein, 1987) believe that modifying the environment is more effective than modifying human behaviour. However, it is likely to depend on the situation. Cohen (1987) thought that a combination of both direct strategies (eg. training and motivation techniques to change behaviour) and indirect strategies (eg. communicating information, incentives, and management factors aimed at changing attitudes and increasing knowledge) are the best at promoting self-protective behaviour.

There are a few basic principles recommended by Cohen, Smith, and Anger (1979) which should be followed in any safety strategy. When training, the learning of safe behaviour should be stressed rather than the unlearning of unsafe behaviour. The benefits of safe behaviour should be promoted and reinforcement should be used for encouragement. Positive reinforcers are generally more effective than negative ones. Using disciplinary action is not highly recommended as induced compliance may not change attitudes or behaviour. The best and cheapest form of reinforcement is immediate feedback. Programmes must be comprehensive, and long term with active employee involvement and direct feedback (Glendon, 1991).

A final factor is the need for management commitment to safety. Studies examining the safety climate and the factors correlated with good safety performance, plus theories of accident causation, all emphasise the role of management. Griffiths (1985) cited a reduction in lost days per annum from 4000 to 21 with the commitment from top management in an industrial gases company.

A combination of methods discussed in this section have been applied successfully to the forest industry (Aminoff & Pettersson, 1982). Painter and Smith (1986) reduced a forest company's accident frequency by 75% and compensation cost by 62% using a hazard management programme based on the behavioural cybernetic principle.

3.9 SAFETY RESEARCH IN FORESTRY

The forest industry has a major interest in safety due to its hazardous operations and high injury rates. In a summary of injury and death rates in New Zealand forestry, Cryer and Ehrman (1988) found the average risk of death between 1975 to 1984 was 8% over a 40 year period. The fatality rate for forestry workers is 30 times higher than the fatality rate of the New Zealand work-force (Marshall, Kawachi, Cryer, Wright, Slappendel, and Laird, 1991). Forestry workers also suffer a large number of serious injuries including chain-saw lacerations, crushed limbs, and have a higher prevalence rate of upper limb pain, and muscle tendon syndromes.

As part of an epidemiological study of injuries among forestry workers, Slappendel *et al.* (1993) reviewed the literature on factors that affect injury rates among forestry workers. For the review, a model of injury causation was created for forestry work, this is displayed in Figure 2. This model provides a means of understanding the factors that contribute to forest injuries.

Physical Environment

Slappendel *et al.* (1993) cite a number of studies that show the thermal climate and terrain can effect safety and productivity. Heat in combination with the heavy work load found in forestry may contribute to fatigue. The cold wet climates found in many forests (including New Zealand) can increase slipping and make jobs difficult to complete (Houghton, 1990; Väyrynen, 1984). The difficult terrain and heavy flora also contribute to accidents (Anon, 1985).

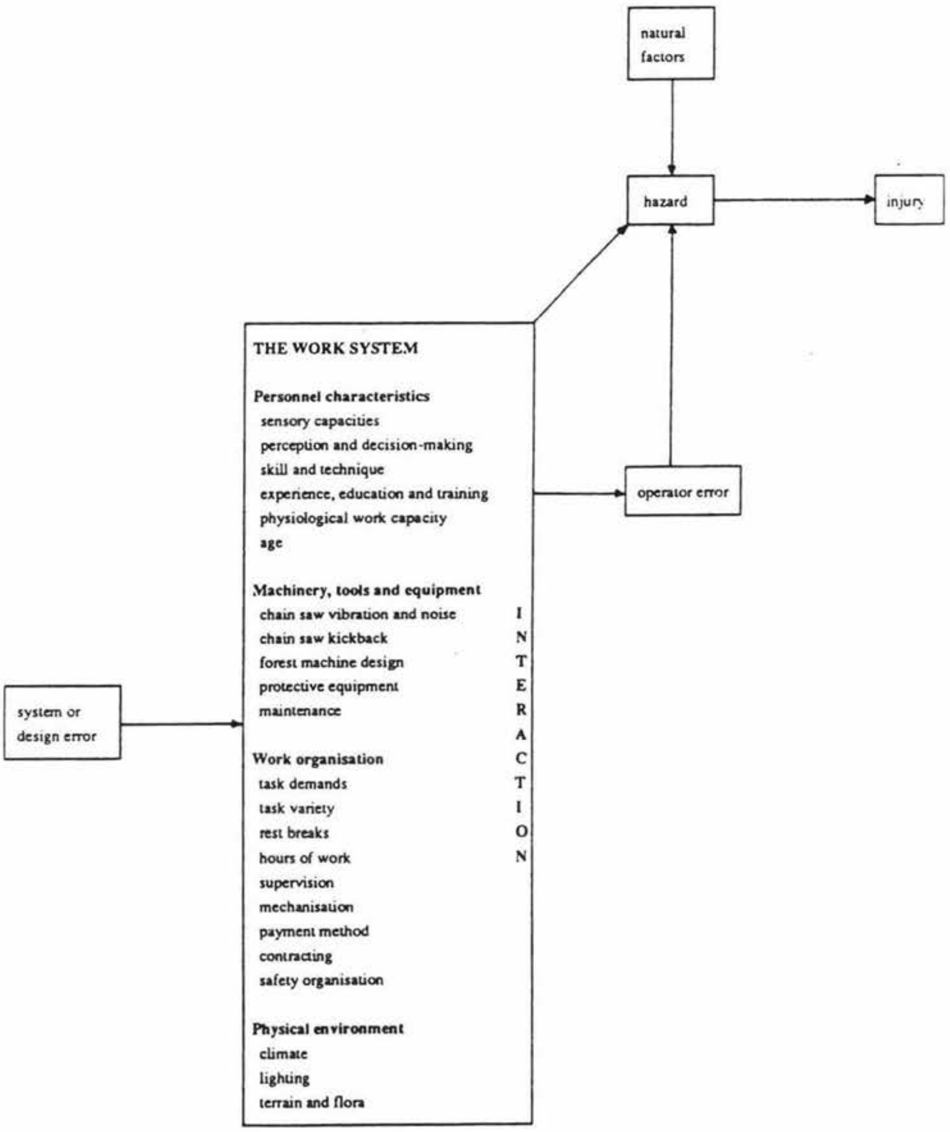


Figure 2. Model of injury causation in forestry work (Slappendel *et al.*, 1993).

Work Organisation

There is debate over whether piece rate payment systems lead to more accidents in forestry. This debate is based on studies which suggest workers will perform dangerous tasks willingly in return for higher wages (Grunberg, 1983; Dwyer, 1992). Crowe (1986) analysed 452 logging accidents in Western Australia and found indications that higher levels of productivity per man were associated with higher levels of accidents. Pettersson, Aminoff, Gustafsson, Lindström, and Sundström-Frisk (1983), and Sundström-Frisk (1984) considered the piece rate or contract payment methods one of the biggest obstacles to reducing accidents. Pettersson *et al.* reported a 32% drop in accident frequency and 35% reduction in accident severity when the payment system was changed from piece rate to salary. However, this was accompanied by a 28% drop in production which could account for the reduced accident rate but not the severity.

When analysing data from Northern Sweden, Ekstrom (1981) found that only a small proportion of the reduction in accidents that occurred when payment was changed to fixed wages could be explained by changes in performance. Other benefits of fixed wages were a more even work tempo, less worry, and a better chance of staying in the job to an older age.

Other factors of the work organisation in forestry that can affect safety are the heavy task demands and insufficient rest breaks. Slappendel *et al.* (1993) note that working with a chain-saw is recognised as very physically demanding. The physically demanding nature of forestry work, in conjunction with the working postures required to perform the job, are responsible for the high number of back problems and other musculoskeletal disorders (Gaskin *et al.*, 1988; ILO, 1981). Without sufficient rest breaks, the heavy workload will lead to fatigue and possible accidents.

Machinery, Tools, and Equipment

A number of studies have examined the effects of chain-saw noise and vibration, demonstrating the negative health effects of such tools (Axelsson, 1977; Bovenzi, Zadini, Franzinelli, & Borgogni, 1991). In an attempt to reduce accidents such as chain-saw injuries and slipping, personal protective equipment has been developed. Since the introduction of chain-saw chaps, Gaskin and Parker (1993) reported that the severity of chain-saw lacerations had decreased. Injuries caused through slipping can also be dramatically reduced by wearing spiked boots (Kirk & Parker, 1992).

Mechanisation is a recognised method of eliminating the majority of hazards in logging (Laflamme & Cloutier, 1988) but it is causing new health problems. Axelsson and Pontén (1990) noticed an increase in the occurrence of RSI with mechanisation. The prevalence rate for "overload syndrome" was also 50%, mainly due to one sided, repetitive, short-cycle working movements with arms and hands required in mechanised operations. Improving the ergonomic design of forest machines should help reduce these occupational injuries (Hansson, 1990).

Personnel Characteristics

Psychological and physiological characteristics of the work-force may contribute to high injury rates (Slappendel *et al.*, 1993). Slappendel *et al.* also noted that there is little research examining human sensory capacities, perception, and decision making ability in the context of forestry work. The need to understand risk decisions and behaviour has been emphasised by Väyrynen and Ojanen (1993). So far, studies on risks have produced conflicting results and are subject to many criticisms (see section on risk).

Poor work technique is an often cited cause of accidents. Parker and Kirk (1993) found inexperienced loggers were exposed to more hazards than experienced loggers due to their poor work technique. Gaskin (1990) also found poor delimbing techniques used by New Zealand loggers resulted in greater compression and shear forces at the L5/S1 intervertebral disc than alternative techniques used overseas. Despite these findings, there are no conclusive studies that show that lack of training is a major cause of accidents in forestry.

There have been conflicting findings with regards to the relationships between age, experience, and accidents. Although the International Labour Organisation (1981) found older workers have a higher proportion of accidents, this trend was not supported by Kawachi, Marshall, Cryer, Wright, Laird and Slappendel (1991). Kawachi *et al.* (1991) also found a lower injury rate among New Zealand loggers with less than one year of experience. In contrast, Klen (1988) found injury rates higher among loggers with less than a years experience.

3.10 SUMMARY

Despite the vast amount of safety research, there have been only limited studies examining the psychological factors that could affect safety in the forest industry (Slappendel *et al.*, 1993). Past studies of risk appear to have major flaws so their usefulness is questioned. Using attitudes to try to identify accident proneness also appears fruitless. However, this review shows that attitudes can provide valuable information regarding safety hardware, software, people, and risk. Attitudes aid in understanding the work environment and the use of personal protective equipment. An insight into the safety climate can also be gained. Attitudes towards accidents and people can also provide an understanding of the attribution biases that may be present in accident investigations. In conclusion, attitudes help understand the psychological characteristics of the work-force, and provide valuable information into the problem of safety, which can then be used as a foundation for designing behavioural interventions.

CHAPTER 4 - RESEARCH DESIGN

4.1 INTRODUCTION

This chapter begins with a description of the process by which the researcher was inducted into the forest industry. The objectives and hypotheses are then presented, followed by initial discussions with potential participants. The design and development of a suitable measuring instrument is discussed, with a section devoted to the pilot testing of the questionnaire. Sampling strategies and data collection procedures are then described in detail, and the analytic strategies required to manage and interpret the data are discussed. The chapter concludes with a section that outlines the activities which have helped extend the results to all participants in the study and the forest industry.

4.2 INDUCTION PROCESS

The management of the Logging Industry Research Organisation (LIRO) were of the opinion that an attitude instrument could not be designed without an understanding of the industry or its work-force. To achieve such an understanding, the researcher studied recent forestry articles and LIRO research to gain a general background knowledge. After this period, one week was spent with a crew doing skid-work and breaking-out. This enabled the researcher to learn a forest worker's job, and become aware of the hazards, work conditions, logging terminology, and the general culture. A second week was spent assisting another researcher conducting a worker profile survey. Through this experience the researcher learnt how to find crews in the forest, approach crews and workers safely by avoiding forest hazards, establish good rapport, and identify potential communication problems such as low reading ages.

These practical skills are very important and may easily be overlooked by an outsider to the industry. Finding silviculture crews is not always an easy task. Directions are often sketchy, and once the crew van is located (by just driving around, following tyre tracks, or looking for recently pruned or planted areas), workers could be anywhere in the forest compartment.

Researchers need to listen out for the sound of pruning shears or voices in the distance, and then head in that direction. It could take from 15 minutes to over 2 hours to locate the crew.

Without an understanding of the job, a person might not identify many hazardous forest situations, thus placing themselves at extreme risk. Due to the method of data collection used in this study, the safety of researchers becomes a major issue, as they are exposed to the same hazards as the workers. When entering the forest, one must drive carefully giving way to large logging trucks, forest machinery, and road-side felling. When locating workers, researchers must watch out for branches and trees that could fall at any time, while also looking out for forest machinery and watching where they step. Fallers must be approached very carefully as they are in the process of felling trees. The researcher needs to identify the direction of felling, and listen to the noise of the chainsaw to detect whether the faller is felling or trimming. Once direction of felling is ascertained and the faller has commenced trimming, the researcher can then approach, but she/he still needs to be aware of skidders, sailors, and other hazards.

Some forest workers are not open to strangers, and may not enjoy being disrupted from their work to be asked a set of questions. It is important to approach workers in the right way, to then identify yourself, and explain the purpose and benefits of the study. Many workers need re-assurance that the researcher is not a bush inspector, and that their replies will not get them into trouble. To re-assure workers, it is generally an advantage to talk about previous forest experiences or current forest news so workers know that the researcher is not an outsider and has an interest in the industry. This is also a good way to establish rapport, which then enables workers to talk freely.

4.3 OBJECTIVES AND HYPOTHESIS

Following the induction phase, the researcher was able to assess the feasibility of the study, formulate objectives and hypotheses, and estimate the time, cost, and resources required to complete the project. The objectives of the study are to:

(1) Evaluate the attitudes of individuals involved in the New Zealand forest industry (managers, supervisors,

contractors, and workers) towards the four object areas of safety (safety hardware, safety software, people, and risk).

(2) Describe the relationship between demographic variables (age, training, experience, education) and safety attitudes.

(3) Determine the current level of understanding of the Health and Safety in Employment Act 1992 at the time of the survey.

(4) Examine attitudes toward accident investigations.

It was hypothesised that:

(1) The four object areas of safety attitudes are distinct from one another.
(2) Rated attitudes towards protective equipment and risk will be higher than rated attitudes toward safety policies and people.
(3) Logging workers will have better attitudes towards protective equipment than silviculture workers.
(4) Safety attitudes will be unrelated to accident involvement.

4.4 INITIAL DISCUSSIONS

A proposal for the attitudes towards safety project was sent to the major forestry companies in the Bay of Plenty asking them if they would like to participate. The companies were: Forestry Corporation of New Zealand Ltd (Waiotapu); Tasman Forestry Ltd (Bay of Plenty District); and Carter Holt Harvey Forests Ltd (Kinleith Region, previously New Zealand Forest Products NZFP Ltd). A meeting was held with supervisors and managers from these companies to discuss the proposal, objectives, time frame, and any other related issues.

A project control plan was then developed and sent to the companies above for approval. The project control plan was also sent to other companies asking if they would participate in the project. These were: Baigent Forests Division (Nelson, now Carter Holt Harvey Forests Southern Division); ITT Rayonier New Zealand Ltd (Gisborne Branch); and Wenita Forestry Ltd (Dunedin). Following a final review by LIRO, approval was given for the project to proceed.

4.5 INSTRUMENT DESIGN AND DEVELOPMENT

To identify studies on attitudes towards safety, an extensive literature search was conducted that included NIOSHTIC, CAB, ABI/INFORM, PSYCH LIT, and LIRO databases. The studies identified in this search have been described in Chapters 2 and 3. This literature, and the induction phase provided the rationale for selecting and developing an attitude-measuring instrument.

A survey using self-administered questionnaires was considered the most appropriate strategy for measuring the safety attitudes of the members of the forest industry. Researchers would personally hand out the questionnaires to crews as a group or individually, depending on the circumstances. This method was chosen due to the potential for a high response rate, the opportunity to explain in person the purposes of the study, as well as establish rapport, offer help, correct misunderstandings, and ensure the questionnaires are completed (Oppenheim, 1992). There is also the advantage of being able to observe behaviour that could give a greater insight into safety attitudes. Finally, if confidentiality is stressed, socially desirable responses should be lower when subjects are filling in a questionnaire as their replies are more anonymous than what would be achieved through personal interviews.

Postal surveys do not have these advantages and are especially inappropriate when reading ages are low. Returns would be low and the sample would not be representative of the population. Personal interviews were considered to be too costly and time-consuming, and would disrupt the companies and contractors a great deal. Having a researcher present to administer the questionnaire is still very costly and time-consuming, but was considered necessary to achieve high response rates and a representative sample.

Questionnaire design began with an examination of questions and scales used in previous research to measure attitudes toward safety. The basic layout of the questionnaire followed the four object areas of safety that were identified by Purdham (1984, cited in Cox & Cox, 1991). The questions covered demographic data, attitudes towards protective equipment, the work environment, risk, safety polices, people, and accident investigations. Suitable statements and questions were chosen from a number of questionnaires (Cox & Cox, 1991; Sherry, 1991; Dedobbeleer & Béland, 1991; Melamed *et al.*, 1989; Leather, 1988; Rotter, 1966). The chosen questions are attached in Appendix B, and a map of the questionnaire layout is presented in Figure 3 below.

Attitude Towards Safety Questionnaire Layout

Page
1 Instructions
2 Demographics
3 Safety Hardware
  Work Environment
  Personal Protective Equipment
4 Safety Policies
4 Risk
5-7 Attitude Statements
7 Safety Awareness
7-8 Perceptions of Commitment
9 Accident Investigations

Figure 3. The layout of the questionnaire

All questions were converted to statements that could be responded to on a 5-point Likert scale (with the exception of the Dedobbeleer & Béland statements). Likert scales were used because of their ease of construction and administration. Each question presented a statement, followed by a 5-point response scale with the scale anchors: strongly disagree, disagree, uncertain, agree, and strongly agree. Other 5-point scale anchors were used for various questions in an attempt to improve the anchors for forest workers. Edwards and Kenney (1946) demonstrated that Likert scales can achieve the same validity as more time-consuming methods (such as Thurstone's scales), making them ideal when time is a limiting factor.

It was necessary to reword some of the questions used in previous research to make them easier to read and more applicable to the forest industry. The education level of the target population had to be taken into account as this varied between individuals, some had university degrees, while others had no formal qualifications. As a consequence, each statement was kept as short and simple as possible. Logging and silviculture workers also have their own slang expressions and, where appropriate, these were incorporated into the questionnaire. This follows the advice of Rotter (1975) and Lefcourt (1982) who stated that for attitude constructs such as locus of control, it is better to develop the scales for specific populations rather than use general, unrelated scales.

Unfortunately, slight changes to the wording of a question can result in very different responses (Rasinski, 1989). However, it was felt that the changes were necessary so that workers could easily understand the statements, especially Cox and Cox's (1991) questions which often contained double-barrelled statements. For example, "Accidents only happen to other people. I am a safe worker". A respondent may disagree with the first part of the question and agree with the second. Other questions were added in relation to other projects being conducted by the Logging Industry Research Organisation.

A variety of positive and negative statements were included to reduce response set bias and to avoid leading the respondents. All attitude statements were randomly placed throughout the questionnaire to reduce order and context effects. Although Likert's (1932) recommendation of preparing extra statements in case some are found to be unsatisfactory during pilot testing was followed, large item pools were not created due to the restrictive time frame available to construct the instrument.

The range of industry members being targeted required six versions of the questionnaire to be developed. These were: Manager, Supervisor, Logging

Contractor, Silviculture Contractor, Logging Worker, and Silviculture Worker.

4.6 PILOT TESTING

When designing measuring instruments, it is necessary to test them to see how well they perform their task. They then need to be adjusted and tested again until they perform adequately. Of paramount importance is the need to meet the requirements and objectives of those involved in the study, namely the forest companies. The next consideration is the layout and the questions themselves. These must be easily understood, otherwise they will be meaningless to the respondents. Finally, attitude scales need to be reliable and valid, otherwise they are difficult to interpret. These requirements can only be met through the pilot testing of all questions and scale anchors.

Four logging crews from Tasman Forestry Limited (Taupo and Murupara) participated in the pilot testing. Each respondent completed the questionnaire with the researcher observing. Respondents were asked to express any opinions they had about any question. The researcher noted down questions that respondents found difficult and all comments that were made. These results were recorded on one questionnaire which was then examined. Several questions were dropped because there was no variance in the replies or the questions added no additional information. The questions that were dropped are attached in Appendix C. Other questions were reworded because workers found them difficult to interpret. The final questionnaire for managers and forest workers is attached in Appendix D. The differences between the questionnaires are also highlighted. After the pilot testing and questionnaire development were completed, managers of the companies participating in the study were given a copy of the questionnaire for their approval.

Despite the pilot testing, a number of faults in the questionnaire were noticed while conducting the survey. These include the length of the questionnaire (too long), the low variance in replies to the attitude statements, and weak scale reliability. However, to improve all three would have been very difficult. Questions that were closely related to another question and achieved similar responses were dropped to shorten the questionnaire. As a consequence, scale reliabilities were reduced as no questions were closely related.

Originally, a reliability test-retest was going to be conducted with three crews. However, the forest industry was in the process of promoting safety and meeting the requirements of the HSE Act during the time of the survey. In addition, the high crew turnover and accident rates accompanied by the safety programmes, would make it impossible to determine the cause of any changes in responses.

4.7 SAMPLING TECHNIQUES

Stratified cluster sampling procedures were used to achieve a representative sample of forest workers. Selecting individuals randomly would be inappropriate due to costs and time involved in collecting data. Forest workers work for contractors who employ a number of workers to make a crew. Crews are spread throughout the forests of New Zealand. If workers were selected randomly, the distance between respondents would have been very large. For instance, an hour drive would be required to get from one worker to another, and then a plane flight might be necessary to get to another forest to survey another worker. Stratified cluster sampling overcame these problems, while enabling a representative sample of the work-force to be surveyed.

Rather than sample crews from all companies, certain companies were selected by the LIRO for various reasons. Forestry Corporation of New Zealand Ltd (Waiotapu), Tasman Forestry Ltd (Bay of Plenty District), and Carter Holt Harvey Forests Ltd (Kinleith Region) were selected because they represent the three largest forest companies in New Zealand. Together they own 54% of New Zealand forests. The other three companies, Baigent Forests Division (Nelson), ITT Rayonier New Zealand Ltd (Gisborne Branch), and Wenita Forestry Ltd (Dunedin) were selected to cover a larger geographical area and include some foreign-owned companies. ITT Rayonier New Zealand Ltd is an American-owned company, and Wenita Forestry Ltd is Japanese-owned. The geographical areas covered by each company division (survey areas) is displayed in Figure 4 below, followed by the general sampling structure in Figure 5.

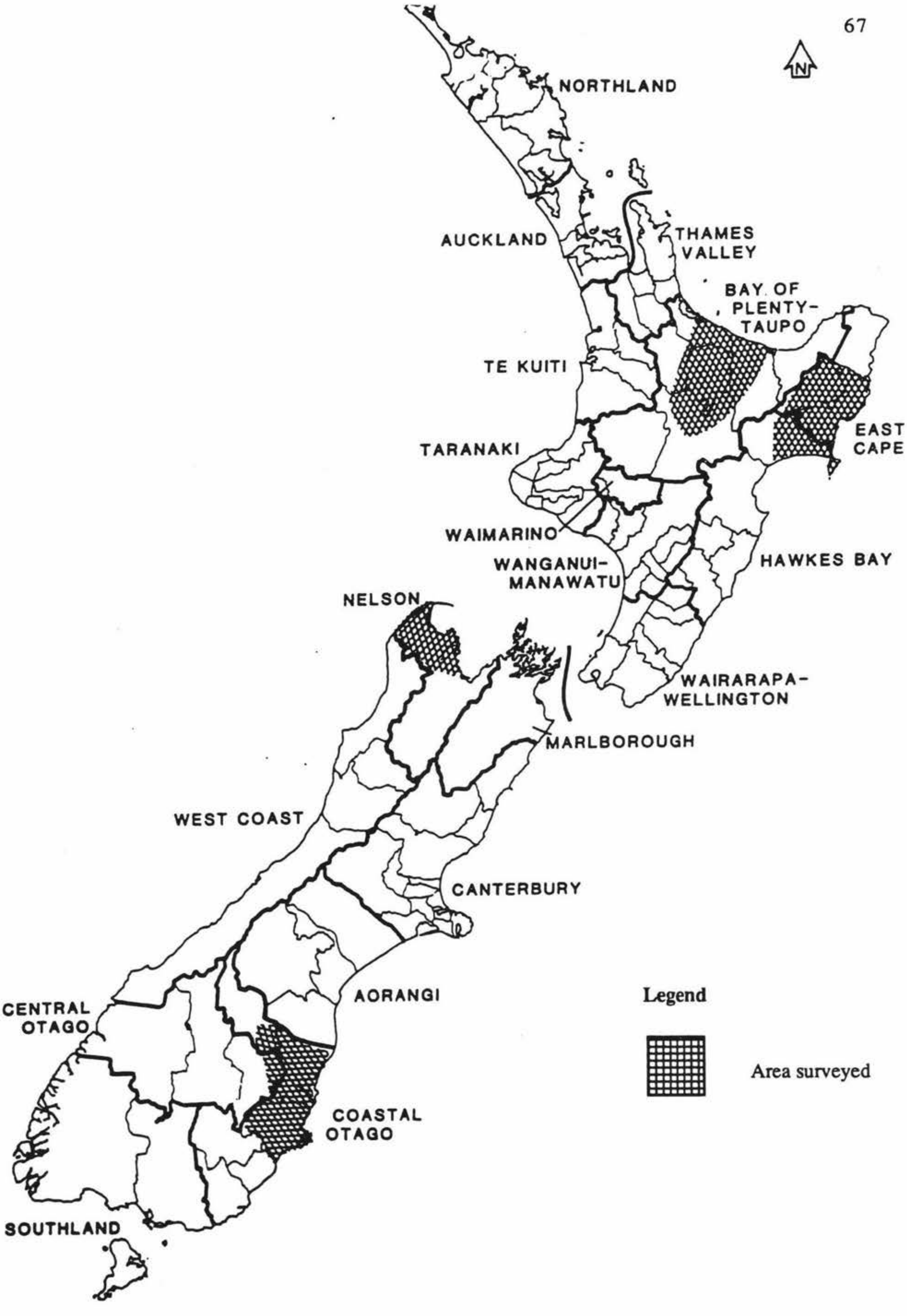


Figure 4. Map of survey areas

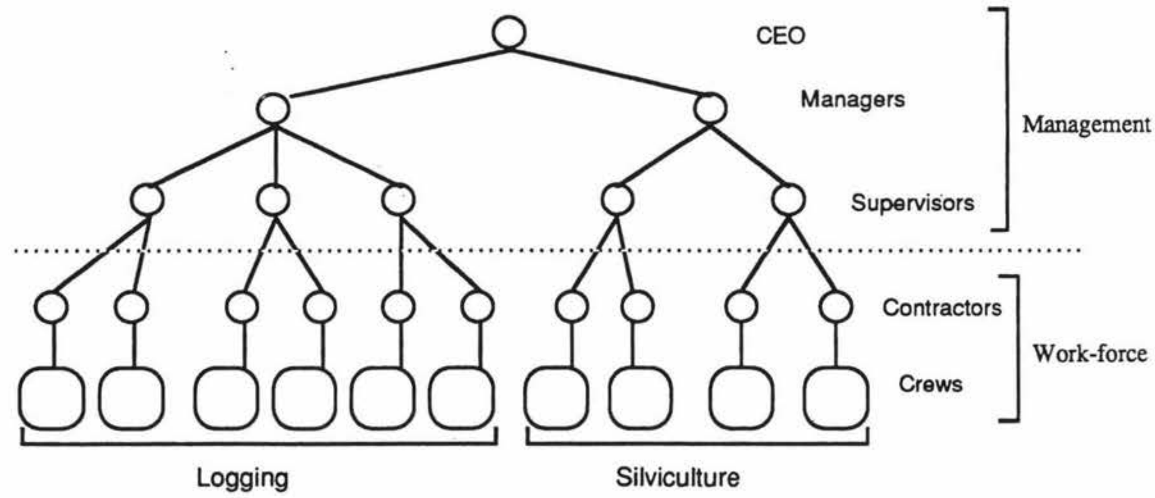


Figure 5. Typical sampling framework for a company division

In each company division there is a Chief Executive Officer (CEO), a logging and forest manager, and several supervisors who each look after a number of contractors. The sampling distribution of respondents depended on company divisional structure. In the larger companies, 10 crews and 5 supervisors were surveyed (generally). In the smaller companies, 8 crews and 4 supervisors were surveyed.

In the initial discussions, it was proposed that the companies select their two best, worst, and average crews in terms of past accident history. Later it was decided that this authoritarian approach would be inappropriate due to the difficulties involved, the advantages of a random sample, and the little variation between the crews with regards to accident frequency. However, one company had already selected six crews according to the original plan and wished them to be surveyed. So for this company the sample was not randomly selected.

Within the other companies, random cluster sampling was used to overcome practical difficulties associated with reaching forestry workers, with the crew being the primary sampling unit (when doing individual analysis). Cluster sampling takes advantage of the natural structure that most populations possess. In the case of forestry, workers are divided into crews and a number of crews are supervised by a supervisor.

The selection of contractors varied depending on the information available. If each supervisors' contractors could be identified, then four or five supervisors were chosen at random. For each of these supervisors, two of their contractors were chosen randomly. If supervisors could not be identified, then a random list of contractors was formed. This was sent back to the company with an instruction to go through the list until four or five supervisors were selected. Once these supervisors had been chosen, the company was to continue down the list until there were two, and only two, contractors for each supervisor. If a selected contractor was not supervised by one of the chosen supervisors, then that contractor was ignored.

At the management level, the regional CEO, forest manager and logging manager were selected. Carter Holt Harvey (Kinleith) has superintendents in between their managers and supervisors so they were also surveyed. It was considered important to survey management given the emphasis placed on management commitment to safety in the safety literature. The planned sample composition is displayed in Table 1.

Table 1.
The planned sample composition

Job title	*N*
CEO's, Managers, and Superintendents	20
Supervisors	28
Logging Contractors	30
Silviculture Contractors	25
Logging Workers	180
Silviculture Workers	175
Total	458

This composition is thought to be representative of each of the chosen companies, and these companies represent the majority of the forest work force.

4.8 PROCEDURE

It is very important to approach respondents correctly to maximise co-operation. Oppenheim (1992) listed a number of practices that lead to increased response rates and co-operation. These include giving subjects advance warning, explaining why they were selected, who is sponsoring the survey, assuring confidentiality, and establishing good rapport. Each of these practices was followed during the survey.

Selected contractors were telephoned to inform them of the study. The researcher identified himself, explained the purpose of the study, and described some of the expected outcomes. Contractors were then asked if they would be willing to participate. If the contractor agreed, information regarding the crew's location, starting time, and rest breaks was gathered. Some companies had sent out letters to their contractors informing them of the study and stating that the company would like them to participate. The companies also informed their supervisors of the study and asked them to co-operate.

Data collection began in June 1993 and was completed by the end of July 1993. The contractors and their crews were visited on-site by the researcher. The locations of contractors were marked on a map with the times of their rest breaks. A plan was established to minimise travel and maximise the number of crews visited in a day by targeting crews during their breaks or before they started work. Unfortunately, this seldom went as planned. If a break was missed then the crew had to be done individually or in pairs. This would take between 1.5 to 3 hours, resulting in other crews being missed that day.

Occasionally assistance was required when administering the questionnaire. Two assistant researchers underwent the induction process and were trained on how to approach workers and administer the questionnaire. These researchers were observed to ensure that they had understood the training. They were also supervised during the survey.

Upon arrival at the forest site, the contractor would be located and approached. Researchers identified themselves, explained the purpose of the visit, and asked whether it would be alright to survey the crew. If the crew were having a prescribed break, or had stopped for various other reasons, the questionnaire was handed out to all crew members (including the contractor). The study was explained to each member and confidentiality was stressed and maintained. If the crew was too busy to stop, the researcher administered the questionnaire to one member at a time.

The researcher(s) were available to the crew to answer any questions or queries that they might have. The amount of time taken to complete the questionnaire varied from 15 minutes to 1 hour (median = 22 minutes). In most cases where the crew had to be disrupted, two researchers went along so that one could take over the crew member's job while the other went through the questionnaire with the worker. All workers in the crew were surveyed, although some loader drivers were too busy to stop.

A copy of the questionnaire was left at the company office for the supervisors to complete in their own time. Managers (logging, forestry, and regional CEO) completed the questionnaire with the researcher present. This enabled the researcher to find additional background information about the companies' current safety goals, programmes and plans.

4.9 ANALYTIC STRATEGY

A data entry form was created using SPSS Data Entry so that the data could be entered in the same way as they appear on the questionnaire. This made errors less likely and data entry easier. Code ranges were specified so that out of range values would be identified immediately and corrected. Two system files were created, one for management (managers and supervisors), and one for the work-force (contractors and workers).

A consistency check was carried out to ensure that the questionnaire was understood and completed carefully. This was done by programming a number of rules into SPSS Data Entry (see Appendix E). Rules were used to alert the researcher that a questionnaire might require close examination. For example, the rule "Gearchek" states that if a person agrees to both "It is important to wear safety equipment at all times while at work" and "I would wear the safety gear I wear now even if it was not compulsory" then they should not agree with the statement "Most of the safety gear is useless at preventing injuries". If three or more rules were broken, it was assumed that the respondent failed to understand some of the questions. As a consequence, these respondents were excluded from the final data analysis.

Skip and fill options were also programmed to make coding easier and more accurate. For example, in the work-force data file, certain variables only applied to contractors. When the identification code is entered, the programme identified the case as belonging to either workers or contractors. If it was a worker code, the computer automatically filled in the value for "not applicable" for all variables that only applied to contractors.

Once the data were coded and rules were checked for each case, data screening was carried out. Data screening was conducted using the SPSSPC FREQUENCIES and REGRESSION commands. First, histograms of all variables were drawn along with summary statistics which included means, medians, standard deviations, kurtosis and skewness values. These were checked for normality, missing data and outliers, although range specification rules should have eliminated all univariate outliers. Secondly, scatter plots were drawn to check for linearity and homoscedasticity.

The third stage of data screening involved a residual analysis of the data to check whether the assumptions of normality applied to the multivariate data. Standardised residual and Mahalanobis distance outliers were calculated and standardised residual histogram, normal probability plot, and scatter plot were then examined. Decisions were made as to whether cases should be dropped, what transformations were required, and how missing data was to be treated.

In a review of appropriate statistical analysis, Allison, Gorman, and Primavera (1993) recommended that, as long as sample sizes are large, the scales are at least ordinal, and there are no major violations of normality, then researchers should employ parametric statistics. The statistical analysis follows the advice of Allison *et al.* (1993) and applies the traditional parametric statistical tests. The application of parametric statistical tests on data collected using Likert scales, which are essentially "ordinal", appears to be an acceptable practice in psychology (Dunham, 1988; Graziano & Raulin, 1993; Nunnally, 1978; Kim, 1975).

Each variable's frequency distribution was presented in table format with management and work-force distributions separated. Variables were then re-coded so that higher values of a variable equated to positive safety responses. A principal components analysis was conducted to see whether the four object areas of safety were distinct from one another and to see if the structure found by Cox and Cox (1991) was present. If the factor analysis failed to converge, attitude variable scales would be created through visual examination of the questions, the correlation matrix, and the results of inter-item reliability analysis.

One-way analysis of variance and chi square tests were conducted using SPSSPC routines to examine various hypotheses. To find whether there were significant differences between the scores of manager/supervisor, contractor/worker, logging/silviculture, formal training/no formal training, and workers who had an accident/no accident, 55 *t*-tests were conducted. With such a large number of *t*-tests, many researchers would suggest that some control should be exercised on the familywise alpha level. If the common alpha level is set at $p = 0.05$, then the chance of a Type I error is 5% for any one comparison. However, over 55 comparisons, the probability of making at least one Type I error is 94% (1 - (0.95 to the power of 55)). If one wishes to keep the probability of making a Type I error at 5% for the whole experiment, a Bonferroni adjustment can be made. This would result in an alpha level of 0.0009 (0.05/55) being set for each comparison, but this would cause the probability of a Type II error to be inflated.

Rothman (1986) questioned whether adjustments such as Bonferroni's actually improve the situation. The arguments in favour of adjustment would need to emphasise the advantage of having false negatives rather than false positives, which has nothing to do with multiple comparisons as the arguments would apply equally to a single comparison. Other arguments against adjusting the familywise alpha level have been put forward by Saville (1990), who stated that changing the probability associated with a particular hypothesis test because other hypotheses are going to be tested appears illogical.

> "Clearly, it is unsatisfactory to have the size of the experiment, or the number of experiments in a project, influencing the probability of detecting a particular pairwise difference" (p.177).

Following the advice of Saville (1990) and Rothman (1986), each comparison is reported as if it is the only comparison, and the reader is left to make their own evaluation.

Using Friedman's (1982) power tables, Cohen's (1988, cited in Allison *et al.*, 1993) recommendation of a power level of 0.8 at alpha = 0.05, and searching for moderate effects $r_m = 0.3$, the required sample size for the analysis is 82. Although the total sample size exceeds this number, some of the splits when making comparisons do fall below 82. For this reason, many of the results should be treated as suggestive, rather than conclusive.

If there were significant differences between scores on the attitude scales for workers who had, and had not had, an accident in 1992, then a discriminant analysis would be carried out to see if the attitude variables could distinguish between the two groups. The SPSSPC "TABLES" option was used to produce crew, company, logging, silviculture, contractor and worker summaries.

4.10 EXTENSION ACTIVITIES

Emphasis has been placed on the extension of the results as LIRO is an applied research organisation providing information directly to the forest industry. Extension activities, which disseminate the results to the participants and the industry as a whole, are an integral part of the research process. Completed extension activities have included:

- Company presentations - to company staff, contractors and workers.
- Other presentations - Massey University, LIRO open day.
- Development of a presentation package to be delivered at forest company meetings around the country, and other interested parties (eg. NZ Loggers Association).
- A full LIRO project report - circulated internationally, is currently in press.
- Magazine article (*NZ Forest Industries, Oct 1993*)
- Reports to all participating contractors with a general summary and their personal crew results (see example in Appendix F).

- Reports to all participating companies with general and company specific summaries (see example in Appendix F).
- LIRO industry display board.
- Discussions with interested parties (ACC, OSH).

These extension activities were very time-consuming, but it was important that people know about any problems identified by the survey so they can be addressed. A journal article is also planned.

CHAPTER 5 - RESULTS

5.1 INTRODUCTION

The first section of this chapter describes the results of data screening and the suitability of the data for multivariate analysis. The demographic characteristics of the sample are then discussed, followed by characteristics of the job. Management and work-force responses to the questionnaire are presented, and from these questions, attitude scales focusing on the four object areas of safety (hardware, software, people, and risk) are created to evaluate managers, supervisors, contractors, and workers attitudes towards safety. The relationship between attitudes and demographic variables are then described. Knowledge of the Health and Safety in Employment Act 1992 is evaluated, followed by the final section examining accidents and attitudes towards accident investigations.

5.2 DATA SCREENING

Prior to analysis, extensive data screening was conducted to ensure all data were entered accurately, responses were consistent, missing values were identified, and the assumptions of multivariate analysis were met. As range values were programmed into SPSS Data Entry, out of range values could not be entered. The consistency check identified 14 cases that broke three or more rules and these cases were deleted from any further analysis. Examination of frequency histograms indicated that most attitude questions were negatively skewed. Due to the large number of variables that had a strong response bias towards the end of the scale, elimination was out of the question. Transformations were considered inappropriate as such a large number would make the data difficult to interpret, so the questions were kept as they were. Unfortunately this skewness limits the variability in the data which is likely to deflate correlations between variables. As expected, splits on some dichotomous variables were uneven, for example, accident in 1992 had a 84% - 16% split. Such uneven splits will also contribute to low correlations, even if variables are strongly related (Tabachnick & Fidell, 1989).

Missing cases on the attitude questions ranged from 1 to 2%. These cases were excluded from the analysis. Where missing values were higher, for example, questions relating to how often a worker talked to their boss and supervisor (missing responses = 16 to 22%), consideration was given to dropping these variables. However the responses were considered important, so group (crew) means were calculated and inserted for missing values. This was done because supervisors and contractors often talk to the crew about safety as a group. Therefore the responses of crew members were generally very similar.

Standardised residual and Mahalanobis distance scores revealed no significant multivariate outliers. The correlation matrix showed that there were no problems with multicollinearity and singularity amongst the variables. The standardised residual histogram, scatter plot, and normal probability plot suggested that there were no violations of normality.

5.3 SAMPLE DEMOGRAPHICS

Seven people declined to participate in the survey (response rate = 98%). These included one manager, one supervisor, four silviculture workers, and one logging worker. One logging crew was missed in company E as they were off work during the week of the survey and time constraints made it impossible to survey another crew. The total sample size is similar to the expected size in Table 1. The size of silviculture crews varied dramatically from 2 to 24 members, so prior estimates of the number of silviculture workers were inaccurate. As a consequence, a larger number of logging workers were surveyed when compared to silviculture. The final sample distribution is displayed in Table 2. The contractors category also includes foreman, as when contractors were not on site, the foremen completed the contractor's questionnaire. In two logging crews, two contractors were present so both were surveyed.

Table 2.
Distribution of respondents by company and job title

	Management		Work-force				
	Managers	Supervisors	Contractors		Workers		Total
Company			Silvi	Log	Silvi	Log	*N*
A	3	4	5	5	11	19	47
B	3	5	4	6	31	34	83
C	7	6	4	9	29	53	108
D	4	5	3	3	14	27	56
E	2	3	3	3	19	13	43
F	3	5	6	6	49	45	114
Total *N*	22	28	25	32	153	191	451

Note : Silvi = silviculture
Log = logging

Age

The mean ages of managers, supervisors, contractors, and workers for each company are presented in Table 3. Managers were the oldest group, followed in descending order by, logging contractors, supervisors, silviculture contractors, logging workers, and silviculture workers who comprised the youngest group. Company F has both young managers and supervisors while company C has the oldest. The mean age of all company personnel was 39 years with a range of 23 to 58 years.

Within the work-force, company D has the oldest workers and company C has the oldest contractors. Both logging contractors and workers had a higher mean age than their counterparts in silviculture. The mean age of loggers was 31 with ages ranging from 16 to 59. Silviculture had a lower mean of 25 years with ages ranging from 15 to 50 years. The age distribution of logging and silviculture workers is displayed in Figure 6.

Gender and Ethnic Origin

There were no females surveyed from within management, however in both silviculture and logging, 2% of the sample were female. Figures 7 and 8 display the proportion of silviculture and logging respondents in each ethnic group. The largest proportion of silviculture respondents were Maori (67%) while the reverse ethnic profile was found in logging with

60% of the sample being New Zealand European. Management consisted of NZ Europeans (88%), NZ Maori (10%), and Australians (2%).

Table 3.
Mean age of respondents by company and job title

	Management		Work-force			
	Managers	Supervisors	Contractors		Workers	
Company			Silvi	Log	Silvi	Log
A	43	36	34	40	23	28
B	35	40	36	40	24	30
C	48	41	38	44	21	29
D	41	40	34	44	27	32
E	42	32	32	32	24	28
F	36	29	27	38	25	29
Mean	**42**	**37**	**33**	**40**	**24**	**29**

Note : Silvi = silviculture
Log = logging
n = 433

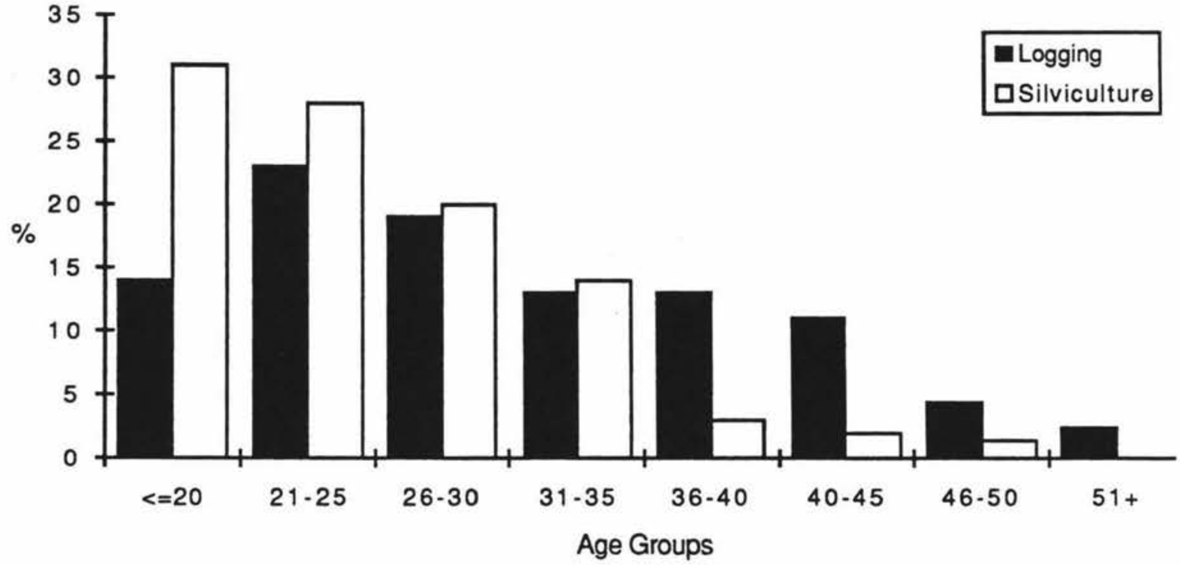


Figure 6. Age distribution of the logging and silviculture work-force

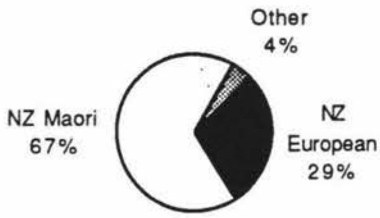


Figure 7. Ethnic origin (silviculture)

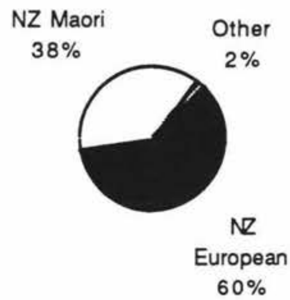


Figure 8. Ethnic origin (logging)

Education

Over half (56%) of the work-force surveyed had spent between 1 and 3 years at secondary school. Another 36% had spent 4 or 5 years at secondary school. Just over half the work-force (54%) had not passed any formal educational qualifications, 18% had passed some school certificate subjects, 5% had attained University Entrance (U.E.), and 4% had Higher School Certificate (H.S.C.). These results are displayed in Table 4. Highest educational qualifications for silviculture and logging workers were almost identical so the combined results only are presented.

Table 4.
Highest formal educational qualification of the work-force

Qualification	%
None	53.7
School Certificate	17.8
University Entrance	5.3
Higher School Certificate	3.9
Trade Certificate	8.2
Diploma	0.7
Degree	0.2
Other	3.4
Missing	6.8

Note: N = 401.

Within management, 26% had passed a trade certificate, 12% had passed a diploma, and 22% had achieved university degrees. University Entrance or Higher School Certificate was the highest qualification for 16% of management, and only 12% had no formal educational qualifications. The remainder had passed School Certificate and various other qualifications.

Experience

In the logging work-force, the median work experience was 6 years with a range from 1 month to 42 years. The median time spent with the current crew was 2 years, with values ranging from 1 week to 30 years. In the silviculture work-force, the median work experience was 3 years with values ranging from 1 week to 25 years. The median time spent with the current crew was 1.5 years with values ranging from 1 week to 19 years (company differences are displayed in the company summary in Appendix F). The median statistic is used for the work-force as their experience distributions are very positively skewed. Supervisor experience ranged from 2 to 29 years with a mean of 17 years. Managers ranged in experience from 7 to 41 years with a mean of 22 years.

Training

The forest industry qualifications that recognise competence in correct practices are the Logging and Forest Industry Training Board (LFITB) Forest Industry Record of Skills (FIRS) Modules. Overall, 50% had passed at least one FIRS module plus the basic requirements (see Appendix F for company differences). Half the work-force also stated that they were presently working towards FIRS modules. The mean age of workers who had passed FIRS modules was 28.5 years, and for workers who had not passed any modules it was 28, indicating that age had no significant impact on the passing of FIRS modules, $t\ (369) = 0.52$, $p = 0.6$. There was also no significant relationship between the passing of FIRS modules, and qualifications [$X^2(6, 352) = 5.7, p = 0.45$], years at school [$X^2(6, 388) = 5.4, p = 0.48$], nor ethnic origin [$X^2(2, 367) = 1.4, p = 0.49$]. In contrast, job experience was positively related to the passing of FIRS modules, the mean experience for workers with FIRS modules was 5.8 years compared with 4.5 years for workers without FIRS modules [$t\ (361) = 2.25, p < 0.05$]. Crew experience was also significantly related to the passing of FIRS modules. The mean crew experience of workers who had passed FIRS modules was 3.8 years, and for workers without FIRS it was 2.8 [$t\ (356) = 2.06, p < 0.05$]. Some workers had also completed polytechnic courses (10% in 1992).

5.4 CHARACTERISTICS OF THE JOB

Jobs Performed

When workers were asked which job they spent most of their time on, job rotation was the most common reply (see Table 5). For logging workers, this included felling, log making, skid work, and occasionally machine operation. Silviculture workers also performed a variety of jobs, although it was observed that their rotation was seasonal or monthly, rather than daily or weekly.

Table 5.
Jobs most frequently performed by the logging and silviculture work-force

Logging Jobs	%	Silviculture Jobs	%
Job rotation	33	Job rotation	49
Felling	17	Pruning with shears	24
Skid work	13	Thinning to waste	8
Skidder operator	9	Pruning with jacksaw	6
Log making	6	Planting	4
Tractor operator	4	Pruning with chainsaw	2
Breaking out	3	Releasing	2
Trimming	3	Mensuration	1
Hauler operator	3		
Bell operator	1		
Other	6	Other	2
Missing	2	Missing	2
n	223	*n*	178

Rest Breaks

Rest breaks are scheduled stoppages for the crew to have lunch, "smoko", or general rest. Crews varied in the number and length of rest breaks they took during the day (see Table 6). The most common pattern, which was reported by 54% of logging crews and 40% of silviculture crews, was two breaks of 30 minutes each. Many crews have just one break which varies in length from between 30 minutes to an hour. A surprising number of silviculture crews (9%) and 1% of logging crews reported having no rest breaks at all.

Table 6.
Rest breaks by length and number (work-force only)

	Length of break in minutes				
Number of breaks	**0**	**30**	**40**	**45**	**60**
Logging (*n* =223)					
0	1%	-	-	-	-
1	-	18%	0%	8%	10%
2	-	54	6	3	0
Silviculture (*n* =178)					
0	9	-	-	-	-
1	-	15	0	0	30
2	-	40	6	0	0

Start, Finish, and Travel Times

The average silviculture worker leaves home at 6.00 am, and returns home around 5.00 pm. These times ranged from 4.00 am to 7.30 am when leaving, and 3.00 am to 7.00 pm when arriving home. The average amount of time spent travelling was 43 minutes each way, with a range of 10 minutes to 2.5 hours. Loggers did not differ greatly from silviculture workers, leaving home at 6.00 am and arriving home at 4.50 pm. Times varied from 3.00 am to 7.30 am, and 3.30 pm to 7.00 pm. Travel times varied from between 5 minutes to 2 hours, with an average of 42 minutes.

Weekend Work

Many loggers reported working at least one day over the weekend as well as the full five day week. Almost half (45%) of the logging work-force were regularly working two or three weekends a month, and 11% were working every weekend. Silviculture workers only rarely worked on the weekend (see Table 7).

Table 7.

Percentage of the logging and silviculture work-force that work on the weekends

Frequency	Logging	Silviculture
Never	9%	37%
Few times a year	22	42
Once a month	13	6
2 - 3 times a month	45	12
Every weekend	11	2
n	222	176

Payment Method

Contractors differed in their method of payment with most logging workers (83%) being paid a wage, 5% a piece rate, and the remaining 12% are on a salary. Piece-rate was the most common form of payment in silviculture (44%). Only 22% of silviculture workers are paid a wage, 12% receive a salary, and the remaining 22% are paid through a combination of methods.

5.5 RESPONSES TO ATTITUDE ITEMS

A large amount of data was collected from both management (managers and supervisors) and the work-force (contractors and workers). The responses to the individual question items are presented in the following tables. The first row represents the work-force replies and the second row presents replies from management. Wherever the statement used in the management questionnaire differs form the work-force questionnaire, the difference is presented after the original statement in brackets. The results from a few questions have not been presented as the data were collected for LIRO studies unrelated to the present study. In all the tables, frequencies may occasionally fail to total 100% due to rounding errors.

Table 8 presents the work-force responses to the question "How often do the following talk to you about safety?". The majority of the work-force reported that their boss spoke to them daily or weekly regarding safety. Ratings for supervisors indicate they talk to the workers about safety less frequently than contractors.

Table 8.

Work-force estimates of the frequency of safety discussions (Q16i - ii).

Q16 How often do the following people talk to you about safety?	Your Boss	Your Supervisor
Daily	34%	8%
Weekly	42	29
Monthly	15	37
Yearly	2	15
Never	7	11

Note: *N* = 401, crew means were inserted for missing values.

Table 9 presents the ratings of environmental conditions. The weather, mud, and weeds received the highest ratings, while noise and vibration received the lowest. Management generally rated the conditions more annoying than did the work-force.

Table 9.
Ratings of environmental conditions (Q17)

Q17	How annoying would you rate the following in your job? (How annoying do you think the following would be to forestry workers?)		Scale Anchors					
			A	B	C	D	E	*n*
(i)	Noise	(W)	39%	39%	12%	7%	3%	388
		(M)	4	22	18	36	20	50
(ii)	Heat		21	41	18	11	9	387
			0	19	17	37	27	49
(iii)	Cold		14	32	20	17	17	390
			2	21	27	31	19	49
(iv)	Weather - rain, wind		8	20	16	22	33	389
			0	2	21	42	35	49
(V)	Dust		13	26	22	20	19	389
			2	8	10	42	38	49
(vi)	Mud		13	25	16	22	24	388
			2	8	17	35	38	49
(vii)	Fumes - eg. smoke		22	26	16	19	17	384
			2	4	21	33	40	49
(viii)	Weeds - gorse,		17	15	12	17	38	384
	blackberry		2	13	15	38	32	49
(ix)	Vibration		37	33	13	10	7	366
			4	21	23	37	15	49

Note: A = Does not annoy me at all. W = Work-force
B = Not too bad. M = Management
C = Slightly annoying.
D = Annoying.
E = Very annoying.

Table 10 shows management and work-force ratings of how helpful they think personal protective equipment (PPE) is. The majority of PPE questions received very high ratings, however many workers failed to rate some items. When asked why they had left these items blank, workers often replied they had never used or seen the PPE so they did not know how good it was.

Table 10.

Ratings of personal protective equipment (Q18)

Q18	How much do you think the following items help reduce injuries?		Scale Anchors					
			A	B	C	D	E	*n*
(i)	Helmets	(W)	3%	3%	5%	13%	76%	384
		(M)	0	0	0	8	92	50
(ii)	Visors		8	5	16	22	49	365
			0	2	18	46	34	50
(iii)	Chaps		3	1	4	13	79	373
			0	0	0	14	86	50
(iv)	Chainsaw trousers		5	3	4	13	75	353
			0	0	2	16	82	50
(v)	Earmuffs		5	1	2	7	86	368
			0	0	4	4	92	50
(vi)	Steel capped boots		1	1	3	7	88	385
			0	0	4	10	86	50
(vii)	Spiked boots		13	3	17	21	46	307
			0	0	28	36	36	48
(viii)	Cut resistant rubber		8	4	12	21	55	343
	boots		0	2	14	38	46	48
(ix)	High visibility gear		9	7	12	22	50	336
			0	2	20	32	46	50
(x)	Chain-saw mitt		6	2	6	19	67	358
			0	0	2	14	84	50
(xi)	Seat-belts		11	3	12	18	56	335
			0	0	4	18	78	50
(xii)	Chain-brake		9	2	8	14	67	362
			0	2	6	32	60	50

Note: A = No help at all.
B = Very little help.
C = Does help a bit.
D = Pretty helpful.
E = Very helpful.

W = Work-force
M = Management

Responses to questions regarding safety regulations and policies are presented in Table 11. Differences between the companies surveyed are displayed in Appendix F. Awareness of the safety policies was generally very low.

Table 11.
Work-force awareness of safety policies (Q19-Q22).

Questions		Scale Anchors A	B	C	D	*n*
Q19	Have you heard of the Health and Safety in Employment Act 1992?	31%	7%	23%	39%	396
Q20	Have you seen your gang's safety policy?	47	3	10	40	392
Q21	Have you seen the company safety policy?	48	4	13	35	392
Q22	Have you seen the Forest Owner's safety policy?	74	3	9	15	391

Note: A = No, they haven't heard/seen it.
B = Yes, but they do not understand it.
C = Yes, but are unsure whether they understand it.
D = Yes, and they understand it.

Table 12 and 13 show the work-force's and management's knowledge of risk. Work-force replies indicate that they are probably guessing, and generally under-estimate the number killed or injured. The number of forest workers killed in 1992 was 9, and the number of reported lost-time injuries recorded by the Accident Reporting Scheme was 197. Management replies are more accurate, but a large number are still not aware of the number of fatalities or injuries.

Table 12.
Knowledge of the number of people killed in forestry accidents (Q23)

	Number killed 1	3	5	7	9	11	13	*n*
Work-force	6%	15%	19%	17%	17%	12%	15%	389
Management	2	2	19	15	27	17	19	49

Table 13.
Knowledge of the number of reported injuries (Q24)

	Number of reported injuries					
	A	B	C	D	E	*n*
Work-force	26%	22%	18%	16%	18%	373
Management	2	8	15	25	50	49

Note: A = 50 to 99
B = 100 to 149
C = 150 to 199
D = 200 to 250
E = 250 to 300

Table 14 shows how strict the work-force thinks their supervisor and contractor (boss) is at enforcing safety. The majority of supervisors and contractors were considered to be strict or very strict.

Table 14.
Work-force impressions of strictness towards safety (Q25)

Q25 How strict are each of the following in enforcing safety?	Scale Anchors					
	A	B	C	D	E	*n*
(i) Your boss	43%	27%	21%	6%	3%	381
(ii) Your supervisor	43	28	21	4	5	360

Note: A = Very strict
B = Strict
C = Fairly strict
D = A little strict
E = Not strict at all

The responses to the attitude statements are presented in Table 15. The statements follow a rough order of hardware, risk, software, and people, but no attempt has been made to statistically group the statements at this stage.

Table 15.
Replies to safety attitude statements (Q26 - Q44)

Questions		A	B	C	D	E	n
		Scale Anchors					
Q26 Working in forestry is very hard physical work.	(W)	1%	2%	1%	42%	54%	398
	(M)	0	0	0	40	60	50
Q27 Working in forestry you need to keep your mind on the job.		1	1	0	31	68	398
		0	0	0	36	64	50
Q28 My work can be very stressful at times.		2	9	11	48	30	396
(Forest work can be very stressful at times.)		0	8	4	58	30	50
Q29 I have control over the speed at which I work.		5	12	6	54	23	394
(Workers have control ... ... they work)		0	16	12	68	4	50
Q30 It is important to wear safety equipment at all times while at work.		1	2	3	31	64	397
		0	0	0	14	86	50
Q31 I would wear the safety gear I wear now even if it wasn't compulsory.		2	7	9	43	40	396
		-	-	-	-	-	-
Q32 There would be less accidents if there was no protective gear because people would be more careful.		56	27	6	6	5	394
		70	28	2	0	0	50
Q33 Most safety gear is useless at preventing injuries.		48	32	10	6	5	393
		66	28	4	0	2	50
Q34 The boss checks that we wear the required gear when working.		3	5	7	56	29	393
		-	-	-	-	-	-
Q35 The supervisor checks that we wear the required gear while working.		3	7	12	51	26	387
		0	2	0	48	50	50
Q36 Forestry is very dangerous work.		1	6	5	37	51	395
		0	26	2	46	26	50
Q37 There is nothing in the job that forces you to take risks. (.. that forces workers to take risks.)		14	29	14	29	14	391
		4	26	12	44	14	50
Q38 I enjoy taking chances.		38	39	9	10	3	386
		-	-	-	-	-	-
Q39 Taking risks is part of forestry.		32	30	9	25	3	394
		54	36	0	8	2	49
Q40 I am more likely to have an accident at home than at work. (Workers are more....)		19	37	21	18	5	395
		6	24	50	20	0	50
Q41 The boss handles safety problems well.		2	3	17	59	19	388
		-	-	-	-	-	-
Q42 The supervisor handles safety problems well.		3	5	21	54	17	387
		0	4	10	70	16	50
Q43 Production pressure has no effect on safety.		33	32	18	13	4	388
		16	60	10	12	2	50
Q44 My on the job safety training was excellent.		3	8	16	55	18	382
		-	-	-	-	-	-

Note: A = Strongly disagree B = Disagree C = Uncertain D = Agree E = Strongly agree
W = Work-force M = Management
Differences between management and work-force questions are placed in brackets.

Table 15 continued.
Replies to safety attitude statements (Q45- Q66)

Questions		Scale Anchors A	B	C	D	E	n
Q45 Safety programmes are very important.	(W)	1%	0%	3%	58%	38%	394
	(M)	0	0	2	32	66	0
Q46 All injuries are preventable.		6	25	16	38	15	390
		6	24	16	36	18	50
Q47 Getting injured is usually just bad luck.		19	48	13	18	2	393
		44	50	6	0	0	50
Q48 I'm too busy to worry about safety.		31	55	5	8	2	392
		70	28	0	2	0	50
Q49 An accident won't happen to me.		33	43	17	5	1	393
		-	-	-	-	-	-
Q50 There is no point in reporting a near miss.		17	40	19	21	3	393
		56	36	4	2	2	50
Q51 Even experienced people need to be reminded		2	1	1	60	36	394
about safety.		0	2	2	40	56	50
Q52 Accidents happen because workers are too		7	24	15	40	13	396
careless.		4	42	10	42	2	50
Q53 I feel that I have little control over the things that		12	56	12	16	4	391
happen to me at work.		-	-	-	-	-	-
Q54 If I worried about safety I would not get my job		9	44	12	28	6	395
done.		36	54	6	2	2	50
Q55 Good drivers don't need to wear seatbelts.		35	49	8	4	4	392
		72	26	0	0	2	50
Q56 Acting safely is respected by my work mates.		1	3	12	65	19	394
(Acting safely is respected by workers.)		0	4	4	62	30	50
Q57 Everybody shares the responsibility for safety.		1	2	3	61	34	395
		0	0	0	22	78	50
Q58 All accidents are avoidable.		4	26	17	35	18	393
		2	28	12	44	14	50
Q59 I can look after my own personal safety.		2	8	9	64	17	396
		-	-	-	-	-	-
Q60 I have a lot of involvement in safety decisions.		3	16	25	45	12	393
		0	8	8	70	14	49
Q61 People who do not follow safety rules endanger		3	1	3	43	50	395
themselves and their work mates.		4	0	0	20	76	50
Q62 There is conflict between safety and other job		5	22	20	41	12	387
demands.		12	44	4	38	2	50
Q63 What happens to me at work is my own doing.		7	36	17	33	7	393
		-	-	-	-	-	-
Q64 I would consider leaving the job because of poor		8	26	18	33	15	394
safety. (Workers would....)		0	18	22	50	10	50
Q65 The forest industry does all it possibly can to		6	15	20	47	13	397
ensure that workers are safe.		6	44	16	30	4	50
Q66 I know how to approach the boss about my safety		2	3	10	71	15	394
concerns.		-	-	-	-	-	-

Note: A = Strongly disagree B = Disagree C = Uncertain D = Agree E = Strongly agree
W = Work-force M = Management
Differences between management and work-force questions are placed in brackets.

The work-force replies to questions regarding awareness of safety programmes, meetings, and goals are presented in Table 16. A large proportion of the work-force was not aware of these factors.

Table 16.
Work-force replies to safety awareness questions (67 to 71)

Questions		Response			
		Yes	No	Don't know	*n*
Q67	Are you aware of any safety programmes operating in your forest?	29%	22%	49%	396
Q68	If yes, do you think they are very effective?	15	19	66	278
Q69	Do you have regular safety meetings?	57	10	33	379
Q70	Does your boss set safety goals?	29	15	56	383
Q71	Does your supervisor set safety goals?	29	22	49	385

Perceptions of commitment to safety are presented in Tables 17 and 18. Some of the figures presented are rather low. Only half of the work-force believes that their boss, supervisor, and work-mates are committed to safety. Within management, only 18% stated that they thought that the work-force would believe that the company is committed to safety (Q72iii). Company differences are presented in Appendix F.

Table 17.
Perceptions of commitment to safety (Q72)

Questions			Response			
			Yes	No	Don't know	*n*
Q72i	Do you think your boss believes that safety is more important than profits, production and quality. (Do you believe safety is ...)	(W)	56%	20%	24%	393
		(M)	82	12	6	49
Q72ii	Do you think your supervisor believes that safety is more important than profits production and quality. (Does your company believe that ...)		52	19	29	388
			68	12	18	50
Q72iii	Do you think your work mates believe that safety is more important than profits production and quality. (Do the workers believe that the company really believes...)		53	20	27	393
			18	44	38	50

Note: Differences between management and work-force questions are placed in brackets.

Table 18.

Perceptions of commitment (Q73 and Q74)

Question			Response A	B	C	*n*
Q73	Which statement best describes how much your boss cares about your safety?	(W)	63%	31%	6%	385
	(...how much you care about...)	(M)	54	44	2	50
Q74	Which statement best describes how much your supervisor cares about your safety?		55	32	13	357
	(....how much your company cares....)		52	44	4	50

Note: A = Does as much as possible to make the job safe.
B = Is concerned about safety but could be doing more to make the job safe.
C = Is really only interested in getting the job done as fast and cheaply as possible.
Differences between management and work-force questions are placed in brackets.

Table 19 shows the work-force and management ratings of each others attitude. Most people rated their own attitude as either good or excellent, but rated their workmate's or worker's attitudes as "alright" or good.

Table 19.

Perceptions of the safety attitudes of other forestry personnel

Q75	How would you rate the following in their attitude towards safety?		Scale Anchors A	B	C	D	E	*n*
(i)	Your boss #	(W)	1%	7%	16%	50%	26%	344
	(The contractors) ##	(M)	0	10	20	62	8	28
(ii)	Your supervisor ###		2	5	21	43	29	401
			0	0	4	54	42	22
(iii)	The trainers		2	6	16	39	38	324
			0	0	2	26	72	48
(iv)	Your workmates		1	5	22	47	25	382
	The workers		0	14	36	46	4	48
(v)	The bush inspector ####		3	7	15	32	44	323
			-	-	-	-	-	-
(vi)	Your own		0	3	10	49	37	385
			0	0	12	52	36	50

Note: A = Doesn't care; B = Bit slack; C = Alright; D = Good; E = Excellent
contractor not included.
managers not included./
supervisors not included.
work-force only.
W = Work-force
M = Management

Management responses to questions regarding responsibility are presented in Table 20. Generally the responses are very positive, with only 10% of managers disagreeing that they are responsible for the safety of their employees. Management were asked a number of other questions which have not been reported in this study as the data was collected for the Logging Industry Research Organisation.

Table 20.
Management attitudes towards responsibility

Questions		Scale Anchors A	B	C	D	E	*n*
Qm1	Safety is a line management responsibility.	4%	4%	4%	34%	54%	49
Qm2	Safety is a condition of employment.	0	0	0	34	66	50
Qm3	Management is responsible for the safety of it's employees.	0	10	0	48	42	50

Note: A = Strongly disagree
B = Disagree
C = Uncertain
D = Agree
E = Strongly agree

All managers, supervisors, contractors and workers were asked "How can safety be improved and accidents reduced in your job?" The replies were grouped into the 12 general categories displayed in Table 21. Some people did not put forward any suggestions and others (particularly management) put forward more than one. For this reason, the frequencies presented are the percentage of management or the work-force that put forward that particular suggestion. Frequencies do not total 100%.

An interesting trend present in Table 21 is that management's suggestions are targeted more at the worker (training, attitude, work technique), while the workers suggestions are targeted at management (less pressure, more pay). This is discussed in Chapter 6.

Table 21.
Suggestions on how to improve safety.

Suggestion.	Management	Work-force
Training and education.	62%	6%
Greater commitment and professional approach.	18	4
Change in attitude required.	16	1
Safer work techniques.	12	6
Greater awareness.	12	2
More safety meetings and programmes.	10	5
Reduce pressure - targets. Slow down.	6	23
Better communication and looking out for yourself.	6	5
Identify the hazards	6	2
Mechanisation	6	1
Increase in pay so you don't have to push yourself.	0	8
Pay more attention, be more careful.	0	4
n	50	401

5.6 COMPOSITE SAFETY ATTITUDE SCALES

Principal Components Analysis

To examine the general structure of the attitude questions, all questions were recoded so a "5" indicated a positive response with regards to safety, and "1" equalled a negative response. Following this, a principal components analysis was run on the work-force data to see if the statements could be reduced to a few factors without too much loss of variance. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.7, and the Bartlett test of Sphericity was significant, suggesting that the data is appropriate for principal components analysis. However, both these measures are influenced by large sample sizes, so cannot be relied upon. Zwick and Velicer (1986) also found the Bartlett test quite inaccurate for determining the number of meaningful factors. Further examination of the data indicated that a factor analysis was not warranted, as virtually all variable correlations were less than 0.3. With such low correlations, factors would be difficult to interpret. As correlations would be deflated due to low variability in scores, and the anti-image correlation matrix (or negative partial correlations) suggested that there were no problematic variables, the principal components analysis was attempted.

The analysis extracted 13 factors which accounted for 61% of the variance. Nevertheless, both orthogonal (varimax) and oblique (oblimin) rotations failed to converge after 24 iterations with convergence = 0.0004. As the analysis could not produce interpretable factors, scales were constructed on the basis of Cox and Cox (1991) distinctions, the correlation matrix, and content examination of questionnaire items. As the correlations between questionnaire items were generally very small they only played a minor role in the construction of the scales. Inter-item reliability analysis was used to test the reliability of the scales. Adjustments were made to maximise the standardised correlation coefficient.

Attitude Scales

The resulting scales build upon, but differ from the structure developed by Cox and Cox (1991). The questions used to construct each work-force and management attitudinal scale, and the standardised reliability coefficients (Alpha) are presented in Table 20. It should be noted that alpha scores are low on a number of scales, demonstrating the difficulty of trying to construct a large number of reliable scales from a single questionnaire, without the questionnaire length becoming too long.

Table 22.
Pooled item safety attitude scales

Scale		Questions	*n*	Alpha
Safety Hardware				
PPE Ratings	(W)	18i - 18xii	245	0.89
	(M)	18i - 18xii	46	0.78
PPE Attitude		30, 31, 32, 33, 55	383	0.55
		30, 32, 33, 55	50	0.53
Work Environment		17i - 17ix, 26, 27, 28, 36	344	0.76
		17i - 17ix, 26, 27, 28, 36	48	0.75
Safety Software				
Safety Arrangements		34, 35, 37, 39, 41 - 44, 48, 54, 60, 62	338	0.77
		34, 37, 39, 41, 43, 48, 54, 60, 62, 64	49	0.73
Safety Awareness		19, 20, 21, 67, 68, 69, 70, 71	256	0.73
		N/A		
People				
Contractor Handling of Safety		16i, 25i, 34, 41, 66, 69, 70, 72i, 73, 75i	291	0.77
		N/A		
Supervisor Handling of Safety		16ii, 25ii, 35, 42, 71, 72ii, 74, 75ii	315	0.81
		N/A		
Scepticism		30, 45, 46, 50, 55, 56, 58, 61	371	0.58
		30, 45, 46, 50, 55, 56, 58, 61	50	0.56
Locus of Control		29, 37, 43, 46, 48, 53, 59, 63	359	0.51
		N/A		
Responsibility for Safety		31, 38, 48, 51, 57, 61	372	0.55
		m1, m2, m3, 48, 51, 61	49	0.60
Risk				
Risk Taking		38, 39, 47	377	0.58
		N/A		
Knowledge of Risk		23, 24	389	*
		23, 24	49	*

Note: N/A = This scale is not applicable to management.
* = These questions were not an attitude scale (knowledge of risk)

Safety hardware has been divided into *personal protective equipment ratings, PPE attitude,* and attitudes towards the *work environment,* which measures how demanding and annoying a person finds their work environment. Management scores on the*work environment* scale reflect how annoying or demanding they think the work conditions would be for the work-force.

Safety software has been separated into *safety arrangements,* and *safety awareness* The *safety arrangements* scale measures the perceptions of the work-force about safety arrangements. It includes questions relating to checks on safety equipment, how well safety problems are dealt with, whether there is conflict between safety and other job demands, and whether risks have to be taken in order to complete the job. The *safety awareness* scale asks questions regarding safety policies, safety goals, meetings, and safety programmes. This scale does not apply to management.

The object area people includes ratings of *contractor handling of safety, supervisor handling of safety,* scepticism towards safety *(scepticism),* perceptions of individual locus of control *(locus of control),* and attitudes towards responsibility *(responsibility).* The *contractor handling of safety* scale indicates workers' ratings of how safety is handled by their boss. It includes questions on safety behaviour, meetings, checks, and ratings of the contractors' attitude. The *supervisor handling of safety* scale is very similar to the *contractor handling of safety* scale except that it concentrates on the supervisor. The *scepticism* scale attempts to measure how safety is valued, and whether people are sceptical about what safety can achieve. The *locus of control* scale included specific questions regarding locus of control in relation to safety.

The final object area, risk, has been split into attitudes towards risk *(risk-taking)* and knowledge of risks *(knowledge).* The *risk taking* scale only consisted of three questions which measured whether a person thought that risks were part of the job, whether they enjoyed taking risks, and whether injuries were just bad luck. This scale only applied to the work-force so management responses were not included. An indication of the work-force's and management's perception of objective risk is gained through the knowledge of risk questions.

5.7 ATTITUDE SCALE SCORES FOR MANAGEMENT AND THE WORK-FORCE

For each attitude scale, a composite attitude score was calculated by adding the question ratings together, and dividing the total by the number of questions used in the scale. This resulted in all attitude scales having a score range of 1 to 5. Any score below 3 represents a poor attitude in that area. Scores in the range of 3 to 4 are reasonable but suggest room for improvement. Scores in the range of 4 to 5 indicate a good attitude towards safety with a score of 5 being excellent. Management scales were slightly different to those used for the work-force due to differences in the questionnaire, so their scores are not directly comparable to the work-force. Appendix G presents graphs showing the company differences on the attitude scales.

Safety Hardware

Table 23 presents the mean scores for management and the work-force on the safety hardware scales. The results of the *t*-tests suggest there are no significant differences between managers and supervisors in their attitudes towards safety hardware. Contractors received significantly higher scores than workers on the *PPE Attitude* scale. Everybody had positive attitudes towards personal protective equipment and rated it very highly. The work environment scale is an exception as low scores do not reflect a bad attitude, but indicate that the work environment is not overly demanding or annoying.

Table 23.
Mean scores on safety hardware scales by job title

Safety Hardware Attitude Scales	*M*	*SD*	*n*	*df*	*t*
Attitudes towards PPE					
Manager	4.6	0.29	20		
Supervisor	4.5	0.34	26	44	1.38
Contractor	4.5	0.55	55		
Worker	4.2	0.59	328	381	3.13**
Ratings of PPE					
Manager	4.7	0.32	22		
Supervisor	4.6	0.39	28	48	0.72
Contractor	4.5	0.71	38		
Worker	4.3	0.78	213	249	1.27
Work Environment					
Manager	3.9	0.39	22		
Supervisor	4.0	0.53	26	46	0.6
Contractor	3.3	0.62	49		
Worker	3.3	0.61	295	342	0.11

Note: ** indicates significant difference ($p < 0.01$).

Safety Software

Safety arrangements scores were reasonable but suggest plenty of room for improvement, especially among supervisors and workers (see Table 24). Supervisor scores were not significantly different from those of managers, but this is largely due to the small size of the management sub-sample.

Contractors achieved good scores on the *safety awareness* scale. Workers were significantly lower than contractors, indicating a lack of awareness of safety policies or programmes.

Table 24.
Mean scores on safety software attitude scales by job title

Safety Software Attitude Scales	*M*	*SD*	*n*	*df*	*t*
Safety Arrangements					
Manager	3.7	0.58	22		
Supervisor	3.4	0.65	27	47	1.68
Contractor	3.7	0.44	48		
Worker	3.5	0.52	290	336	2.74**
Safety Awareness					
Contractor	4.0	0.88	45		
Worker	3.4	0.92	211	254	3.71**

Note: ** indicates significant difference ($p < 0.01$).

People

Table 25 shows that contractors rated themselves highly on their handling of safety. Workers were not as generous in their ratings, but still indicated that generally they thought contractors were handling safety adequately. Contractors and workers both gave supervisors good ratings for their handling of safety.

Table 25.
Mean scores on the people attitude scales by job title

People Attitude Scales	*M*	*SD*	*n*	*df*	*t*
Contractor Handling of Safety					
Contractor	4.1	0.52	50		
Worker	3.8	0.65	288	336	3.24**
Supervisor Handling of Safety					
Contractor	3.9	0.75	46		
Worker	3.8	0.76	270	314	1.11
Scepticism					
Manager	4.0	0.7	22		
Supervisor	3.7	0.6	28	48	1.94
Contractor	4.1	0.43	56		
Worker	3.9	0.47	315	369	2.53*
Locus of Control					
Contractor	3.5	0.43	53		
Worker	3.3	0.53	306	357	1.72
Responsibility for Safety					
Manager	4.5	0.37	22		
Supervisor	4.4	0.45	27	47	0.97
Contractor	4.4	0.46	56		
Worker	4.1	0.48	316	370	3.69**

Note: * indicates significant difference ($p < 0.05$).
** indicates significant difference ($p < 0.01$).

Managers and contractors received good scores on the *scepticism* scale. Workers scored significantly lower than contractors, however it was the supervisors who displayed the most scepticism with a low mean of 3.68.

The work-force as a whole did not tend towards either an external or an internal *locus of control* (see Table 25). Scores ranged from 1.6 to 4.6 and followed a normal distribution, indicating that only a few members of the work-force scored at the extremes of the scale. Contractors and workers did not differ greatly in their perceptions of control over safety.

Everybody had good attitudes towards *responsibility*, although workers once again received significantly lower scores than contractors (see Table 25).

Risk

Contractors had good attitudes towards *risk taking* and acheived significantly higher scores than the workers (see Table 26). Worker scores were reasonable but suggest some negative attitudes towards risk. Objective knowledge of risk was not that high among management or the work-force (see Tables 12 and 13), as they were not aware of the actual number of workers that are injured or killed each year in forestry.

Table 26.
Mean scores on the risk attitude scale by job title

Risk Attitude Scale	*M*	*SD*	*n*	*df*	*t*
Attitude Towards Risk Taking					
Contractor	4.0	0.75	57		
Worker	3.7	0.85	320	375	2.13*

Note: * indicates significant difference ($p < 0.05$).

5.8 SAFETY ATTITUDES AND DEMOGRAPHICS

Age and Experience

To examine whether age or experience influenced attitudes, Spearman's rank order correlation coefficients were calculated between each attitude scale, and age, job experience, and crew experience (see Table 27). The only significant relationships were between age and *safety awareness* ($r = 0.23, p < 0.05$), job experience and *safety awareness* ($r = 0.24, p < 0.05$), and between job experience and *locus of control* ($r = 0.24, p < 0.05$). These correlations are very small suggesting that the impact that age and job experience has on these attitude areas is minor.

Table 27.
Rank order correlation coefficients between age, crew experience, job experience and attitude scales (work-force only).

Attitude Scale	Age	Job Exp	Crew Exp
PPE Rating	0.17	0.05	0.07
PPE Attitude	0.12	0.01	0.08
Work Environment	0.03	0.03	0.04
Safety Arrangements	0.18	0.18	0.16
Safety Awareness	0.23*	0.24*	0.16
Scepticism	0.10	0.08	0.06
Responsibility for Safety	0.16	0.05	0.04
Locus of Control	0.13	0.24*	0.16
Contractor Handling of Safety	0.03	0.05	0.06
Supervisor Handling of Safety	0.18	0.06	0.11
Risk Taking	0.22	0.10	0.04

Note: * indicates significant r ($p < 0.05$).

Education

One-way analysis of variance with Duncan's groupings was conducted to examine the relationship between educational qualifications and attitudes, and years at school and attitudes. The harmonic mean of all group sizes was used for all comparisons in range tests as group sizes were unequal. There was no significant relationship between qualifications and attitudes. There was also no linear relationship between years at school and attitudes. However, members of the work-force who spent just one year at school scored significantly higher, than those who had spent six years at school, on the *safety arrangements, locus of control,* and *contractor handling of safety* scales. The mean *safety arrangements* score for those with one year of secondary schooling was 3.7, compared to a mean of 3.3 for those with six years of secondary schooling [F (5, 328) = 2.6, $p < 0.05$]. For *locus of control*, M = 3.5 for the one year group, and M = 3.0 for the six year group [F (5, 348) = 2.5, $p < 0.05$]. Finally, the mean *contractor handling of safety* score for the one year schooling group was 4.1, compared with a mean of 3.4 for the six year group [F (5, 328) = 2.4, $p < 0.05$].

Logging versus Silviculture

Table 28 displays a number of very significant differences between the attitudes of the logging and silvicultural work-force. Loggers had better *PPE attitudes* and *PPE ratings*, find the *work environment* more demanding/annoying, had a greater *safety awareness*, and generally thought the *safety arrangements* were slightly better. Loggers also accepted more *responsibility* for safety, had better attitudes towards *risk taking*, and rated their *supervisor's handling of safety* higher. There was no difference between logging and silviculture on ratings of *contractor's handling of safety*, or in *locus of control* scores.

Training

Formal training was measured by the passing of the Forest Industry Record of Skills (FIRS) modules. While workers who had passed FIRS modules achieved slightly higher scores on all attitude scales (see Table 28), only the difference for *work environment* scale was significant ($p < 0.05$).

Table 28.
Mean attitude scores by type of work and training

Attitude Scales	*M*	*SD*	*n*	*df*	*t*
Safety Hardware					
Attitudes towards PPE					
Logging	4.3	0.55	213		
Silviculture	4.1	0.61	170	381	3.46**
Passed FIRS Modules	4.2	0.65	193		
No FIRS Modules	4.2	0.52	180	371	0.75
Ratings of PPE					
Logging	4.4	0.48	152		
Silviculture	4.1	1.00	99	127 a	3.11**
Passed FIRS Modules	4.4	0.68	126		
No FIRS Modules	4.2	0.85	122	246	1.37
Work Environment					
Logging	3.4	0.61	203		
Silviculture	3.2	0.6	141	342	3.23**
Passed FIRS Modules	3.4	0.59	180		
No FIRS Modules	3.2	0.61	157	335	2.25*
Safety Software					
Safety Arrangements					
Logging	3.6	0.53	199		
Silviculture	3.4	0.47	139	366	2.91**
Passed FIRS Modules	3.5	0.49	183		
No FIRS Modules	3.5	0.54	146	327	1.25
Safety Awareness					
Logging	3.6	0.96	152		
Silviculture	3.4	0.97	104	254	2.22*
Passed FIRS Modules	3.6	0.96	135		
No FIRS Modules	3.5	0.91	114	247	1.21

Note: * indicates significant difference ($p < 0.05$).
** indicates significant difference ($p < 0.01$).
a indicates separate variance estimate.

Table 28 continued.

Mean attitude scores by type of work and training

Attitude Scales	*M*	*SD*	*n*	*df*	*t*
People					
Contractor Handling of Safety					
Logging	3.9	0.68	191		
Silviculture	3.8	0.60	147	336	0.87
Passed FIRS Modules	3.9	0.60	172		
No FIRS Modules	3.8	0.69	160	330	1.59
Supervisor Handling of Safety					
Logging	4.0	0.68	187		
Silviculture	3.5	0.81	129	243[a]	4.92**
Passed FIRS Modules	3.8	0.74	165		
No FIRS Modules	3.8	0.78	144	307	0.58
Scepticism					
Logging	3.9	0.5	208		
Silviculture	3.9	0.43	163	369	0.19
Passed FIRS Modules	3.9	0.47	185		
No FIRS Modules	3.9	0.46	175	358	1.04
Locus of Control					
Logging	3.3	0.54	209		
Silviculture	3.4	0.49	150	357	1.04
Passed FIRS Modules	3.3	0.54	186		
No FIRS Modules	3.3	0.51	163	347	0.32
Responsibility for Safety					
Logging	4.3	0.45	209		
Silviculture	4.0	0.49	163	370	5.31**
Passed FIRS Modules	4.2	0.49	191		
No FIRS Modules	4.1	0.48	172	361	1.91
Risk					
Attitude Towards Risk					
Logging	3.9	0.77	210		
Silviculture	3.6	0.89	167	375	4.16**
Passed FIRS Modules	3.8	0.88	191		
No FIRS Modules	3.7	0.81	175	364	1.26

Note: * indicates significant difference ($p < 0.05$).
** indicates significant difference ($p < 0.01$).
a indicates separate variance estimate.

5.9 THE HEALTH AND SAFETY IN EMPLOYMENT ACT 1992

All contractors were aware of the HSE Act although 19% were unsure as to whether they fully understood it. Despite this high level of awareness, only 57% of contractors had a crew safety policy, and some of these contractors were referring to the company policy rather than their own separate policy. Awareness of the HSE Act was much lower amongst workers with 36% saying they had not heard of the Act and only 39% stating that they understood it. All managers and supervisors were aware of the Act, although 2% stated they did not understand it and 8% were unsure about it. Company differences are displayed in Appendix F.

5.10 ATTITUDES TOWARDS ACCIDENT INVESTIGATIONS

Accident Frequency and Severity

In both logging and silviculture, 16% of the work-force surveyed reported having had a lost-time accident in 1992. Logging accidents were more severe than those occurring in silviculture and resulted in a mean of 33 days off work and a median of 6.5 days. The mean is distorted because of one accident causing 1 year off work. The mean for silviculture was 15 days with a median of 4 days. Figure 9 displays the number of days lost due to accidents in logging and silviculture. The majority of accidents resulted in less than one week off work.

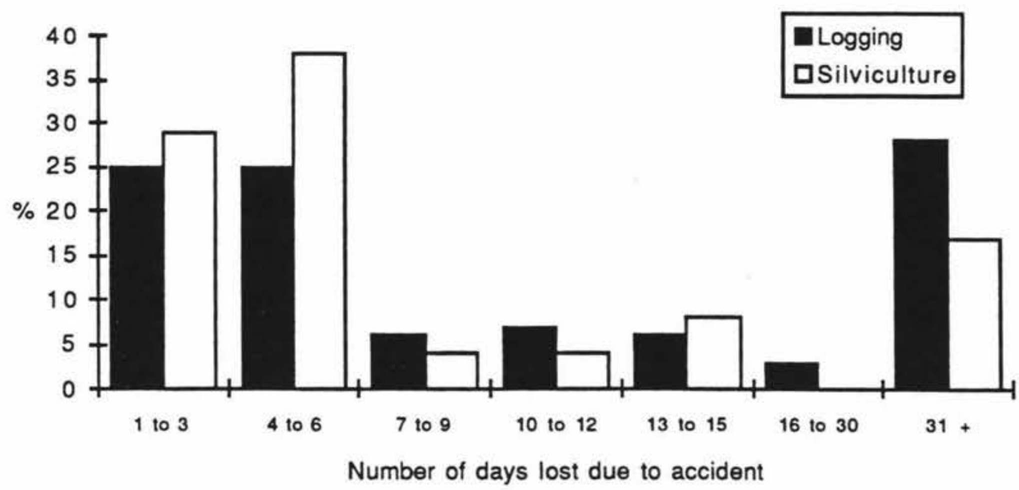


Figure 9. Accident severity by type of work.

The number of days spent in hospital after an accident is presented in Table 29. The majority of silviculture injuries (79%) did not result in hospitalisation. A large number of logging injuries (56%) required one day in hospital with the maximum number of days spent in hospital totalling 14 days.

Table 29.
Number of days in hospital by type of work

	Type of work	
Days Spent in Hospital	Logging	Silviculture
0	29%	79%
1	56	17
3	3	0
5	6	4
7	3	0
14	3	0

Note: These were the actual replies, it was not a forced choice format

Accident Involvement and Demographics

Accident involvement was not related to educational qualifications (X^2 (6, 346) = 6.3, p = 0.34), years at school (X^2 (6, 382) = 11.0, p = 0.09), ethnic origin (X^2 (61 386) = 0.01 p = 0.95) or payment method (X^2 (4, 376) = 4.7, p = 0.32). Job and crew experience were also unrelated to accident involvement. The mean number of years of job experience of those workers who did not experience a lost-time accident in 1992 was 5.2, and for workers who did have an accident the mean was 5.3; t (356) = -0.11, p = 0.914. The mean crew experience of workers who did have an accident was 3.4 years, and for workers without an accident in 1992 the mean was 3 years; t (350) = 0.64, p = 0.52.

The age of workers who did not have an accident in 1992 (M = 28.9) was significantly higher than the age of workers who did have an accident (M = 25.8), t (82.1) = 2.82, $p < 0.01$. Another significant relationship was found between workers who had received Forest Industry Record of Skills (FIRS) modules (formal training) and accident involvement Workers who had not passed FIRS modules were involved in less accidents than those who had FIRS modules X^2 (1, n = 371) = 3.82, p = 0.05. Workers working towards

FIRS modules had also been involved in more accidents X^2 (1, n = 349) = 6.05, p = 0.01.

Accident Involvement and Safety Attitudes

None of the attitude scales were significantly related to lost-time accident involvement in 1992 (see Table 30). The proposed discriminant analysis to see whether attitudes can distinguish between workers who had experienced an accident, and workers who had not, was not run as the means of the two groups did not differ significantly on any attitude scale.

Table 30.

Mean attitude scale scores by accident involvement

Attitude Scales	*M*	*SD*	*n*	*df*	*t*
Safety Hardware					
Attitudes towards PPE					
No accident in 1992	4.2	0.56	314		
Had a lost-time accident in 1992	4.2	0.56	54	366	0.16
Ratings of PPE					
No accident in 1992	4.3	0.78	209		
Had a lost-time accident in 1992	4.2	0.72	34	241	0.67
Work Environment					
No accident in 1992	3.3	0.61	282		
Had a lost-time accident in 1992	3.3	0.63	49	329	.11
Safety Software					
Safety Arrangements					
No accident in 1992	3.5	0.52	277		
Had a lost-time accident in 1992	3.5	0.52	48	323	0.33
Safety Awareness					
No accident in 1992	3.5	0.93	210		
Had a lost-time accident in 1992	3.4	1.03	36	244	0.54
People					
Contractor Handling of Safety					
No accident in 1992	3.8	0.64	279		
Had a lost-time accident in 1992	3.8	0.68	46	323	0.41
Supervisor Handling of Safety					
No accident in 1992	3.8	0.76	263		
Had a lost-time accident in 1992	3.7	0.80	42	303	0.42
Scepticism					
No accident in 1992	3.9	0.45	305		
Had a lost-time accident in 1992	4.0	0.53	52	355	0.63
Locus of Control					
No accident in 1992	3.3	0.51	295		
Had a lost-time accident in 1992	3.3	0.56	50	343	0.48
Responsibility for Safety					
No accident in 1992	4.2	0.47	303		
Had a lost-time accident in 1992	4.2	0.52	52	353	0.36
Risk					
Attitude Towards Risk					
No accident in 1992	3.8	0.83	308		
Had a lost-time accident in 1992	3.7	0.82	52	358	0.66

Safety Attitudes and Accident Investigations

Table 31 shows that only 24% of workers stated that somebody came back and checked that the safety recommendations following an accident were carried out, with another 18% unsure if there was any follow-up. The crew got together to see how the accident occurred after only 24% of the accidents in 1992. In the majority of accidents (65%), workers did not receive any assistance to help them recover and re-enter the work-force. Despite this apparent lack of follow-up procedures, only 21% of the workers who had been involved in an accident were unhappy with the subsequent investigation (see Table 32).

Table 31.
Victim's knowledge of accident procedures

	Response			
Questions	**Yes**	**No**	**Don't know**	***n***
Recommendation followed up [a]	24%	58%	18%	54
Crew discuss accident [b]	24	54	22	54
Assist re-entry into work-force [c]	26	65	9	53

Note: a = Q85 Did anyone come back later to check that the recommendations or advice?
b = Q87 After the accident did the gang get together to see how it happened and how it can be avoided?
c = Q88 Did anybody assist your recovery and entry back to the work-force?

Table 32.
Victim's satisfaction with the accident investigation

	Scale Anchors					
Question	**A**	**B**	**C**	**D**	**E**	***n***
Q89 How happy were you with the investigation that took place after your accident and the advice given?	13%	8%	28%	36%	15%	54

Note: A = Very unhappy
B = Unhappy
C = Alright
D = Happy
E = Very happy

5.11 SUMMARY

A number of interesting findings were discovered in this study. Overall, safety attitudes of management were good and those of the work-force were reasonable, but certain areas could certainly be improved. Managers had the most positive attitudes towards safety, although they doubted whether the work-force would believe that they were committed to safety. Logging workers displayed better safety attitudes than silviculture workers. FIRS training had no effect on safety attitudes and was not related to a reduction in accidents. Age was related to accidents indicating older workers were involved in less accidents. Age had no impact on safety attitudes and attitudes were not related to accident involvement. Finally, recommendations made after an accident do not appear to be followed up. There is also a lack of any rehabilitation programmes. Despite these problems, most workers were satisfied with the investigation procedures.

CHAPTER 6 - DISCUSSION

6.1 INTRODUCTION

The results are discussed in relation to the objectives and hypotheses stated in Chapter 4. To begin, the representativeness of the sample to the population of forest workers is briefly described. The structure of attitudes towards safety is then discussed and compared to the structure presented by Cox and Cox (1991). Thirdly, attitudes towards the four object areas of safety are evaluated and discussed with reference to the implications they have for the forest industry. Awareness of the Health and Safety in Employment Act 1992 (HSE Act) is also described within the safety software section. The relationship between the demographic characteristics of the sample and safety attitudes is then examined, followed by the final section on accidents and attitudes towards accident investigations.

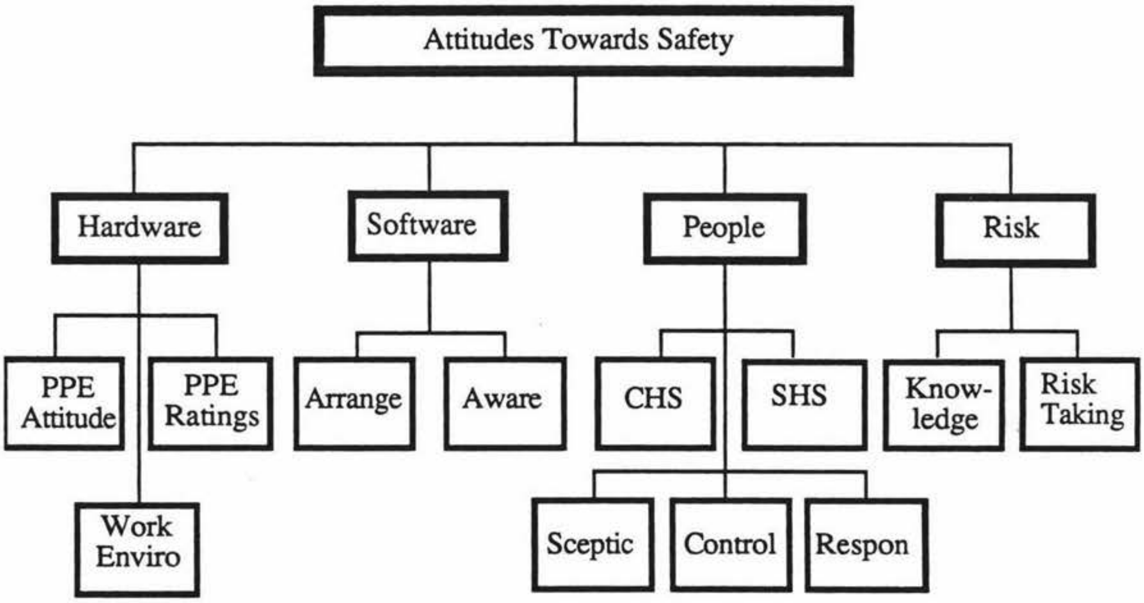
6.2 SAMPLE REPRESENTATIVENESS

The demographic results for the logging work-force are very similar to previous studies. The mean of age of the logging work-force in this study was 31 years with a range of 16 to 59 years. This is almost identical to the worker profile survey by Gaskin, Smith, and Wilson (1989) which found a mean age of 31.7 years and a range of 15 to 62 years. Job and crew experience in this study were also very similar to the results reported by Gaskin *et al.*, with less than 1 year difference in job experience, and 4 months difference in crew experience. Finally, years spent at secondary school were equal in both studies; 56% had spent 1 to 3 years at secondary school. These findings suggest that the logging work-force sample is very representative of the general logging work-force.

There is no comparable data for silviculture or management. However the same sampling technique was used for both silviculture and logging. Therefore, if the logging sample is representative, it is assumed that the silviculture sample will also be representative. With regards to management, all managers involved in logging and silviculture in the selected company divisions were surveyed. The majority of supervisors within the companies were also surveyed, so the management sample should be representative of the selected company divisions. The company divisions should be representative of the selected companies as a whole, and these companies in turn, represent a large proportion of the New Zealand forest industry management in logging and silviculture.

6.3 THE STRUCTURE OF ATTITUDES TOWARDS SAFETY

The results of the principal components analysis failed to produce an interpretable attitude structure due to the low correlations among the variables. As a consequence, scales were constructed by following Purdham's (1984, cited in Cox & Cox, 1991) distinction between the four object areas of safety, and expanding on the structure developed by Cox and Cox (1991). The resulting structure is displayed in Figure 10 below.



Note:
PPE = Personal Protective Equipment
Work Enviro = Work Environment
Arrange = Safety Arrangements
Aware = Safety Awareness
CHS = Contractor Handling of Safety
SHS = Supervisor Handling of Safety
Sceptic = Scepticism (over the value of safety)
Control = Locus of Control
Respon = Responsibility Towards Safety
Knowledge = Knowledge of Injuries and Fatalities
Risk Taking = Attitudes Towards Risk Taking

Figure 10. The structure of attitudes towards safety

The structure includes all four object areas of safety identified by Purdham (1984, cited in Cox and Cox, 1991). This contrasts with the Cox and Cox (1991) study which did not examine safety hardware, but suggested that it may influence the other three object areas. Cox and Cox also suggested that each object area is distinct, however this study found that the object areas were related to each other. This relationship was increased due to the occasional inclusion of the same question in more than one scale. For example, the statement "I would wear the safety gear I wear now even if it was not compulsory" has been used in this study to indicate an attitude towards *personal protective equipment*, and an attitude towards accepting *responsibility* for one's own safety. Another example is the statement "I'm too busy to worry about safety" which reflects an attitude towards *safety arrangements, locus of control,* and *responsibility*.

The "software" object area includes a similar *safety arrangements* scale to that defined by Cox and Cox. In addition, a *safety awareness* scale has been included. The object area "people" consists of the scales *scepticism* and *responsibility* which were also used by Cox and Cox. In addition, "people" has been expanded in this study to incorporate attitudes towards the people most likely to have an impact on worker safety, namely the contractor (*contractor handling of safety* scale) and supervisor (*supervisor handling of safety* scale). The "people" object area also includes individual's beliefs about *locus of control* with regards to safety. Under the object area "risk", the sub-structure completely differs from Cox and Cox. Their *personal immunity* scale was not included as it only consisted of two questions, and their *safeness of the work environment* was not included as questions relating to this scale appeared to belong under the *safety arrangement* scale. For this study, "risk" included attitudes towards *risk taking* and *knowledge of risk*.

While the structure in Figure 10 was based upon reference to object definitions, logic, item correlations, and reliability coefficients, they are, nevertheless, based upon the decisions of the author. Scales could be constructed in other ways or grouped differently. For example, all software scales could be combined to produce one software scale with a high inter-item reliability coefficient of 0.8. However it was felt that such a scale would be more difficult to interpret. The chosen structure does contain a number of scales with low inter-item reliability coefficients, so should be interpreted with caution. Despite these limitations, the scales do provide a reasonably comprehensive structure for evaluating safety attitudes.

6.4 EVALUATION OF THE ATTITUDES TOWARDS SAFETY

Safety Hardware

Following the structure described above, safety hardware includes attitudes towards personal protective equipment (*PPE attitude*), the helpfulness of personal protective equipment (*PPE rating*), and scores of how annoying and demanding the work conditions are (*work environment*).

Managers, supervisors, and contractors had very good attitudes towards personal protective equipment. Worker scores were significantly lower than contractors on the *PPE attitude* scale, nevertheless they were still very positive (see Table 23 or Figure 11).

Contributing to the positive *PPE attitude* scores was the high helpfulness ratings of PPE, especially steel-capped boots, chaps, chain-saw trousers, helmets, and earmuffs. The silviculture work-force *PPE rating* scores were significantly lower than those of the logging work-force (see Table 27), probably due to the fact that a lot of the PPE being rated did not apply to silviculture workers. This finding supports hypothesis 3, which states that "logging workers will have better attitudes towards PPE than silviculture workers".

Recently developed PPE items (such as high visibility clothing) received lower scores of helpfulness from the work-force than the PPE items mentioned earlier, although many workers had not personally tried them. Although no past attitude studies have been conducted in the New Zealand forest industry, many workers made the comment that attitudes towards PPE have changed dramatically over the last ten years. It was not long ago that PPE items were considered inconvenient and "sissy". This study suggests that many workers will now not work without PPE.

Despite the high scores and positive attitudes (especially by management), some PPE items have only recently been made compulsory by the forest companies. For example, Bradford, Isler, Kirk, and Parker (1992) demonstrated that high visibility clothing increases the chance of loggers being seen by operators of machinery and other loggers, and Kirk and Parker (1992) found that spiked boots dramatically decrease the number of times fallers slip over in slash and on logs. Yet only a few forest companies have made the wearing of high visibility clothing compulsory in some New Zealand forests, and spiked boots are still not actively promoted by many forest companies.

When workers were questioned by the researcher as to why they did not have certain items of PPE, the most common reply was that PPE "cost too much". This provides support for Wogalter *et al.*'s (1987) conclusion that "cost of compliance" is one of the most important factors relating to PPE usage. To the workers, the expense of PPE items, such as spiked boots, appeared greater than other personal costs such as discomfort or extra workload. PPE usage can be increased by promoting the benefits of PPE through information feedback similar to that used by Zohar *et al.* (1980), or by other means such as personalising the equipment (by adding names), and management leading by example (Feeney, 1986). However, if the expense of the PPE is the main cause of non-usage, then contractors or companies need to target this particular problem, either by providing the PPE, or including financial incentives such as discounted prices.

The third scale under safety hardware, *work environment*, indicated that the work-force finds the environmental conditions slightly annoying, with the weather receiving the highest annoyance scores (see Table 8). Weather in New Zealand forests can vary from freezing conditions in winter with heavy rain or snow, to extremely hot temperatures in the summer. Although the weather itself cannot be changed, there are a number of actions that can be taken to assist workers in physically demanding conditions. Providing workers with adequate shelter during rest breaks, increasing fluid intake during hot weather, and having good ergonomically designed clothing, could help reduce discomfort.

A surprising result was that noise and vibration were rated as the least annoying conditions, especially considering the large amount of research devoted to the detrimental effects these conditions have on forestry workers (Axelsson, 1977). This could indicate that some success in reducing noise and vibration has been achieved through improved design of chain-saws and machines, or alternatively, it could mean that the demands of working in the cold and rain are often underestimated in relation to more obvious factors such as noise.

The logging work-force found the environmental conditions more annoying than silviculture workers, mostly due to annoyance associated with the mud which was rated much higher by loggers. Managers and supervisors did recognise how annoying environmental conditions can be for the workers, but overestimated their annoyance value. Contractor and worker scores were very similar to each other on the *work environment* scale (see Figure 11).

The results did not support the findings of Melamed *et al.* (1989) who discovered a relation between ratings of annoyance with respect to environmental conditions, and accidents, especially when jobs were ergonomically demanding. Virtually all jobs in forestry could be considered as very "ergonomically demanding" according to Melamed *et al.'s* definition, and support for this can been seen in studies examining the physiological cost of forest work (Parker & Kirk, 1994). Table 30 shows however, that there was no difference in annoyance rankings of workers who did and did not have an accident.

Both logging and silviculture workers reported that they need to keep their mind on the job and that the work could be very stressful at times (see Table 15). Due to the hazardous conditions, workers need to constantly pay attention. This requires a high level of vigilance that may be impossible to maintain over long periods of time due to limitations of the perceptual and sensory systems (eg. visual monitoring). The demanding physical component of forestry has long been recognised, however little work has been conducted examining the mental workload of motor-manual logging (Slappendel *et al.*, 1993). Results suggest that this aspect of forestry needs to be investigated further as it is a possible cause of forest accidents.

In summary, attitudes towards safety hardware were very positive in both management and the work-force. This finding is displayed in Figure 11 below.

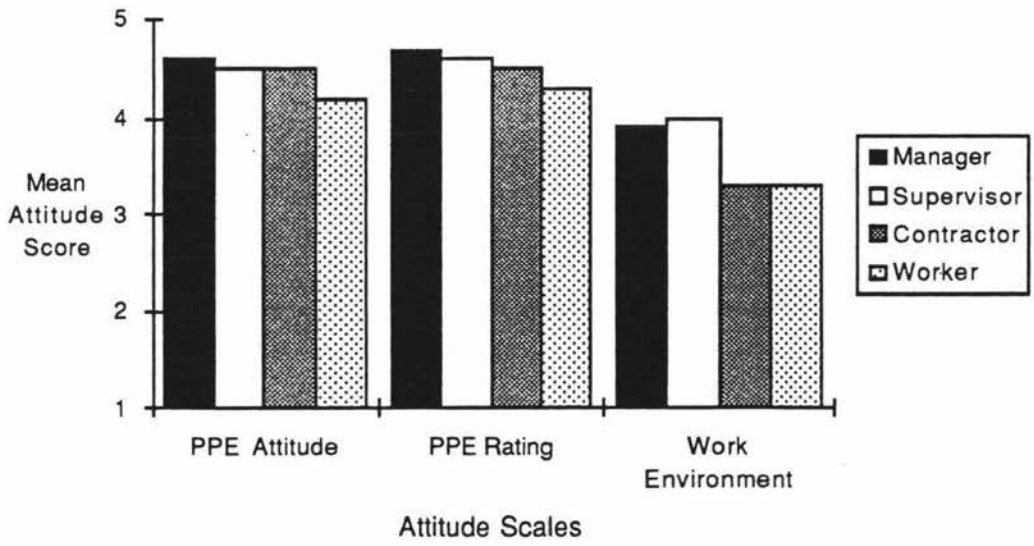


Figure 11. Mean safety hardware scores by job title

Safety Software

Safety software refers to safety policies, rules, and management factors. In this study, attitudes towards safety software have been measured by the *safety arrangements* and *safety awareness* scales.

Managers and contractors had similar attitudes towards *safety arrangements* with both groups rating the *safety arrangements* as reasonable. However, there was definitely room for improvement in the scores. Supervisor and worker scores of *safety arrangements* were slightly more negative, with silviculture workers expressing more dissatisfaction with the *safety arrangements* than loggers (see Table 28).

Two statements summarise the work-force's dissatisfaction with current safety arrangements. Only 17% of the work-force disagreed with the statement "Production pressure has no effect on safety", and 53% agreed that "There is conflict between safety and other job demands" (with 20% uncertain). These responses indicate that the work-force does not believe safety is coming first. This conclusion is further supported by the responses to question 72 (see Table 15), which suggests a lack of commitment to safety. Workers had low perceptions of commitment with only 53% believing that their boss was committed to safety (ie. placed safety before profits, production, and quality), while 48% believed their supervisor was committed, and 52% believed their workmates were committed to safety. Results for contractors were slightly better, with 75% saying they believed safety was more important than profits, production, or quality, 67% thinking that their supervisor was committed to safety and 59% thinking that their workers were committed to safety.

Managers and supervisors were also asked whether they believed that "Safety is more important than profits, production and quality", whether their company believed it, and whether they thought workers would believe that the company was committed to safety. The majority of supervisors (81%) stated that they believed safety was most important. Only 59% of supervisors thought the company believed that safety was most important, and only 14% stated that the workers would believe that the company was committed to safety. Most managers (82%) stated that they did believe that safety was more important than profits, production, or quality, and a further 80% stated that their company believed this. However, only 27% of managers thought that the workers would believe that the company was committed to safety. Company differences are displayed in graph form in Appendix F.

While it is encouraging to see that the majority of management stated that they were committed to safety, there are some managers, supervisors and contractors who do not believe that safety is the first priority. Furthermore, 40% of management agreed with the statement "There is conflict between safety and other job demands". Management were also aware that the safety climate (as indicated by workers' perceptions of management commitment) is poor, although their impression of this climate was perhaps somewhat too pessimistic.

These results appear to conflict. Management state that they are committed to safety, yet believe there are conflicts between safety and other job demands, and that the work-force will not believe that management are committed to safety. However, if management was truly committed, then surely they would have addressed the problem of conflicting job demands and the negative safety climate. These results suggest management still has some way to go in terms of improving safety arrangements and convincing the work-force of their commitment to safety.

Safety awareness scores were low among workers. Many workers were unaware of (crew or company) safety goals, safety programmes, safety policies, or the Health and Safety in Employment Act 1992 (see Tables 11 and 16). Contractor scores were significantly higher than those of workers, with the majority of contractors being aware of the HSE Act, safety policies, and programmes, although 57% did not have their own crew safety policy. This may demonstrate a lack of understanding of the HSE Act, as it explicitly states that employers must have a safety policy. On the positive side however, most of the companies and contractors were in the process of implementing new health and safety policies at the time of the survey, so awareness may have improved since then. A real effort still needs to be made to educate and continually remind people about these safety matters. Walters and Haines (1988) suggested that workers would pursue safety matters more if they are aware of their rights and mechanisms for dealing with hazards.

All management stated that their company had safety goals and targets, yet many were unaware of their own company's progress towards the goal, and some (including the majority of the work-force) were unaware what the goal was. This finding is very important as safety goals will not be very effective unless everybody is aware of the goal and is given constant feedback on progress towards the goal (Reber *et al.*, 1990).

When summarising attitudes towards safety software, it may be concluded that the work-force *safety arrangements* and *safety awareness* scores were low. Although the majority of the work-force stated they were committed to safety, the majority did not believe that others were also committed to safety. These negative perceptions of commitment, the impression that there is conflict between safety and other job demands, and the lack of awareness of safety goals and programmes, suggest that the safety climate in forestry needs to be improved. The reported management commitment to safety is not evident in the *safety arrangement* scale, *safety awareness* scale, nor in the work-force's perceptions of safety. These findings are displayed in Figure 12 below.

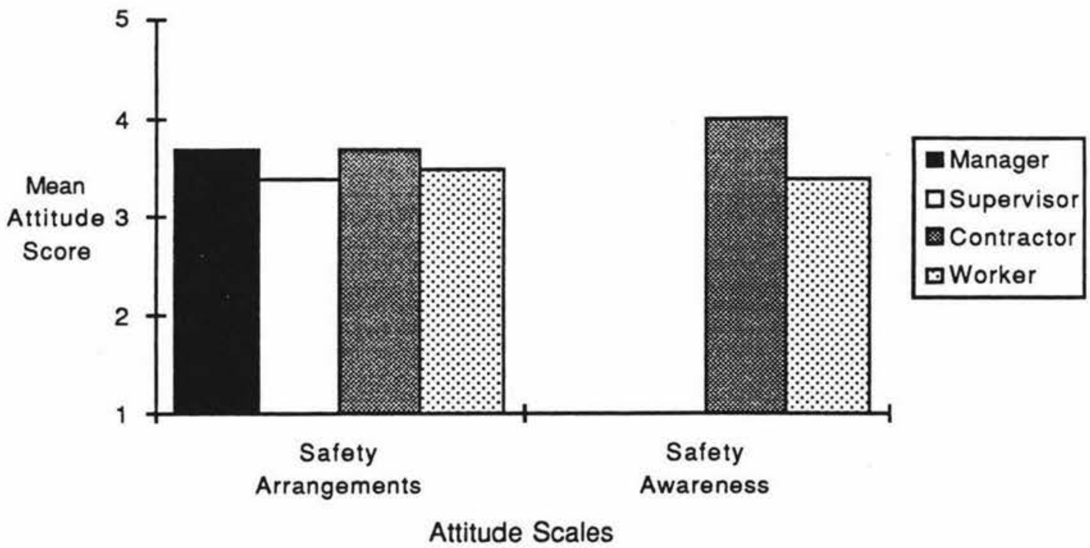


Figure 12. Mean safety software scores by job title

People

Following the structure presented in Figure 10, attitudes towards people includes the scales: *contractor handling of safety, supervisor handling of safety, scepticism, locus of control,* and *responsibility*. Although contractors rated their own handling of safety highly, workers were not as generous in their evaluations and rated contractors significantly lower than the contractors rated themselves. Nevertheless, the workers still rated most contractors' attitudes and handling of safety positively. This finding suggests that the majority of contractors make regular checks on safety equipment and emphasise the importance of safety.

Supervisors received scores similar to contractors regarding their attitudes and handling of safety. However, silviculture supervisors received significantly lower scores than logging supervisors (see Table 28) suggesting that logging supervisors place more emphasis on safety. It is interesting to note that the higher scores received by logging supervisors also corresponds with the logging work-force achieving higher scores on most of the safety attitude scales when compared to the silviculture work-force. Supervisor commitment may have contributed to this difference as safety research emphasises the important role of the supervisor in improving safety (Hale & Glendon, 1987; Dejoy, 1985; Dejoy, 1990).

Managers and contractors achieved good scores on the *scepticism* scale, suggesting a low degree of scepticism about the value of safety. Worker responses were significantly lower than contractors indicating a little scepticism among workers regarding the value of safety. The surprising result was that supervisors achieved the lowest score on this scale. This result does not imply that supervisors believe safety is ineffective. However it does imply that many are a little sceptical about what safety can achieve. For example, a number of the work-force (31%) and management (30%) were sceptical about the idea that "All injuries are preventable". This statement must be hard to believe in the forest industry as forestry work is conducted in a changing environment and there are some factors that are hard to control and predict. In addition, the high number of injuries that continue to occur despite efforts to reduce accidents must reinforce the belief that all accidents are not preventable. Despite these difficulties, "All injuries are preventable" must be part of management safety policy or accidents will be accepted as part of the job or just as bad luck. When this happens, active steps are not taken to avoid the same accident happening again in the future (Griffith, 1985).

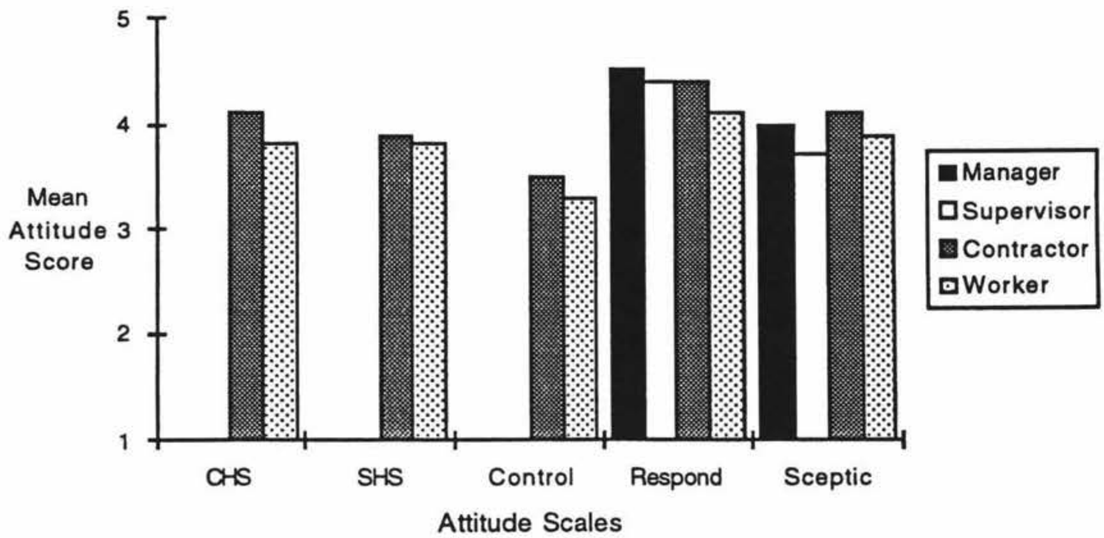
Locus of control with regards to safety examines whether individuals perceive they have control over their own safety (internal locus of control), or whether they perceive that safety is outside their own control (external locus of control). Scores on the *locus of control* scale tend slightly towards "internal" but suggest that the work-force is divided over perceptions of control. Very few people scored at the extremes of the scale so most individuals would not be classified in either the internal or external category. Perception of control differed for various aspects of the work. Although many of the work-force felt they were forced to take risks, and what happens at work is not their own doing, 77% felt they had control over the speed at which they work.

Contractor and worker scores did not differ significantly on the *locus of control* scale. This is slightly surprising as one would expect contractors to be more internal in control, as they have control over the work methods employed by the crew, and the speed at which the crew works. A possible explanation for the similar results obtained by contractors and workers is that the contractor may feel that the company controls the speed of work and the work methods used by the crew. Alternatively, this finding may also be a consequence of forestry accidents being viewed as difficult to control due to the changeable natural environment.

Increasing workers' perceptions of control over safety could have positive and/or negative effects on safety (Joe, 1971; Eyssen *et al.*, 1980; Shouksmith, 1990). Although the actual control workers have over their safety should be increased by training, people need to be careful of illusions of over control. Over confidence in one's ability is dangerous and can lead to accidents (Hale & Glendon, 1987).

Responsibility scores were very good among management and contractors. Workers scored significantly lower than contractors, but still displayed good attitudes towards responsibility. The situation in logging was once again significantly better than in silviculture. The results suggest that management does accept responsibility for the safety of its employees (see Table 20) and workers agree that safety is everybody's responsibility (see Table 15). These results are very positive as accepting responsibility for safety is one of the key components to improving safety (Griffith, 1985).

Overall, both management and the work-force have positive attitudes towards people. These results, and the differences between managers, supervisors, contractors, and workers are displayed in Figure 13 below.



Note: CHS = Contractor Handling of Safety; SHS = Supervisor Handling of Safety; Sceptic = Scepticism; Control = Locus of Control; Respond = Responsibility Towards Safety

Figure 13. Mean people scores by job title

Risk

Risk consists of the *risk taking* scale, and objective knowledge of risk (see Tables 12 and 13). There were only three questions in the *risk taking* scale as other questions relating to risk were placed in the *safety arrangements* scale. Contractors' *risk taking* scores were significantly higher than those of workers and suggest a good attitude towards risk. Workers' scores were reasonable, but suggest some negative attitudes towards *risk taking*. The silviculture work-force had substantially lower scores than the logging work-force, indicating some acceptance or negative attitude towards risk.

An interesting comparison can be made between the present study, and that by Tapp *et al.* (1990) which found that logging workers were aware of the risks in their jobs and raised the question "why are the risks not avoided"? The answer may be due to 28% of the work-force and 10% of management thinking that taking risks is part of the job, 43% of the work-force reporting that there are aspects of the job that force you to take risks, and 14% of the work-force stating that they actually enjoyed taking chances. If deliberate risks are considered as part of the job then they will never be avoided.

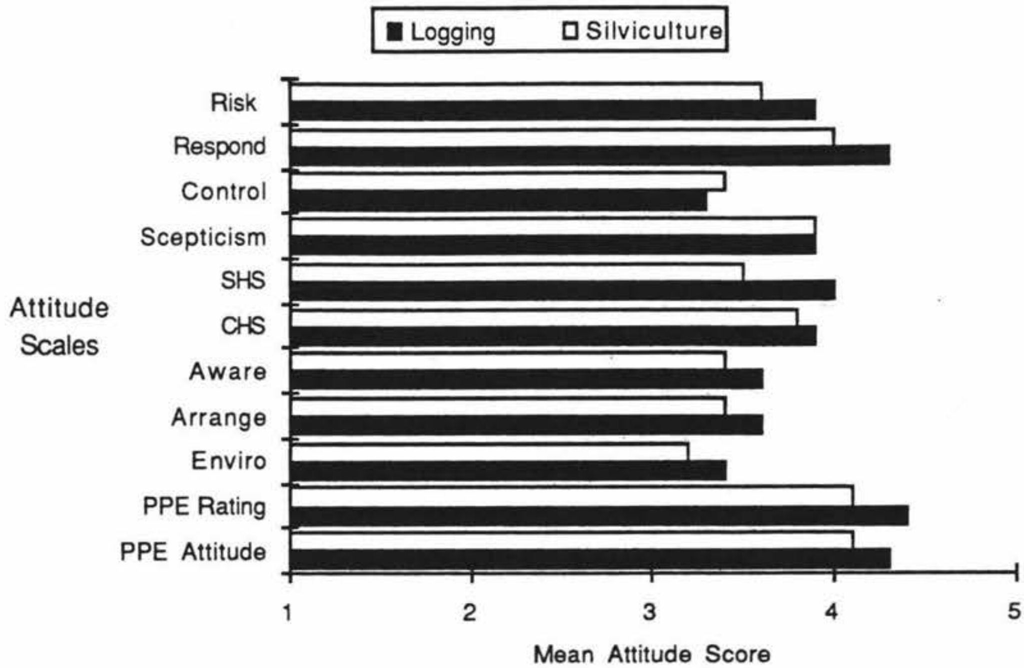
The conclusion drawn by Tapp *et al.* (1990) that loggers are aware of risks may be unfounded due to the problems with risk perception studies that were discussed earlier in Chapter 3 (such as the failure to measure objective risk, and the use of questionable objective data). Furthermore, Tables 12 and 13 suggest that the majority of people in the forest industry are unaware of the actual number of workers that are injured or killed each year in forestry. Although the data in these tables are still not accident rates, they indicate a lack of knowledge amongst the work-force and management. The work-force tended to underestimate the risk, and management generally over-estimated the risk.

To increase the perception of risk amongst the work-force, accident figures should be presented so they have an impact. Using the fatality rate reported by Gaskin (1988), if one's lifetime (30 years) is spent logging, the chance of being killed on the job is 7%, or one in every fourteen workers. This appears more impressive than reporting that the number of people killed in logging during the 1992 calender year was nine. Griffeth and Rogers (1979) reported that safety behaviour was improved by increasing perceptions of severity and chance expectancies of accidents, however others have found that changing risk perceptions will not necessarily influence behaviour (Hale & Glendon, 1987; Weinstein, 1987; Howarth, 1988). This does not imply that presenting accident statistics and objective risk is not worthwhile however, since such data should help motivate some workers and management to take more interest in safety.

Although *attitudes towards PPE* was the most positive attitude area, attitudes towards *risk taking* were lower than the scales relating to people (*scepticism, locus of control,* and *responsibility*) and only slightly higher than attitudes towards safety software (*safety arrangements* and *safety awareness*). These findings imply that hypothesis 2, which stated that "attitudes towards PPE and risk will be more positive than attitudes towards safety policies and people", was not fully supported.

In summary, the majority of the work-force and management have positive attitudes towards safety, although *safety arrangements* and *safety awareness* need to be improved. The problem with present arrangements for safety may stem from the view that current work demands conflict with working safely. However, the concern over work demands may have been exaggerated at the time of the survey as the forest industry was going through a "boom" period.

There are no significant differences ($p < 0.05$) between the attitudes of managers and supervisors on any of the attitude scales. This is likely to be a consequence of the small management sample size as there were some large differences between managers and supervisors on a number of scales. There were a number of significant differences between contractors and workers which suggest contractors do have better attitudes towards safety. The logging work-force also achieved higher scores on the majority of attitude scales when compared to the silviculture work-force. This is displayed in Figure 14 below.



Note: PPE = Personal Protective Equipment
Enviro = Work Environment
Arrange = Safety Arrangements
Aware = Safety Awareness
CHS = Contractor Handling of Safety
SHS = Supervisor Handling of Safety
Control = Locus of Control
Respond = Responsibility Towards Safety
Risk Taking = Attitudes Towards Risk Taking

Figure 14. Mean attitude scores by type of work

6.5 GENERAL SUGGESTIONS ON IMPROVING SAFETY

There were some very interesting differences between management and the work-force in terms of their suggestions for improving safety. Management frequently emphasised the need for more training and education which gives the impression that they believe workers (or factors relating to workers) are the prime cause of accidents (see Table 21). Management replies to the question "What do you think is the underlying cause(s) of most accidents" were also based around factors relating to the worker (responses not presented) such as a lack of training, education, and poor work techniques. These causation replies are a mirror image to the responses given the question relating to improving safety, indicating that management views of causation and views of prevention are closely related. These results support Brown's (1984) argument that upper management will show stronger biases towards internal attributions. Not all managers and supervisors displayed this particular bias however. Some managers and supervisors identified management factors as potential causes of accidents. These factors included a lack of professionalism and forest owners not accepting ownership of the safety problem.

Recent accident causation models discussed in Chapter 3 emphasise management's impact on accident causation (Dejoy 1990; Wagenaar *et al.*, 1990). The results of this study suggest that management are making the fundamental attribution error (over-estimating dispositional influences and under-estimating situational influences) by placing too much emphasis on the worker as a cause of accidents. Dejoy (1985) stated that if management's attributions are biased, then this could lead to inappropriate remedies to prevent future accidents being introduced. This issue is discussed further in section 6.7 on accident investigations.

External attributions were found in the work-force with the most popular recommendation being to reduce pressure (23%) followed by increasing pay (8%). These replies by the work-force suggest that they believe the prime cause of accidents are the demands of management. Only a small number of the work-force (6%) emphasised the need for more training and education.

The need for greater commitment and a more professional approach to safety was mentioned by 18% of management and 4% of the work-force. This need is apparent in the responses to the questions relating to commitment (see Tables 17 and 18), and was discussed earlier in the section on safety software. The large number of the work-force who were unaware of safety goals suggests that safety is not being handled in the most effective manner. All companies stated they had safety goals, however very few people knew what these goals were or how their current progress towards the goal was proceeding. Given the reported effectiveness of safety programmes that use safety goals with feedback and reinforcement (Krause *et al.*, 1984; Reber *et al.*, 1990; Sutherland *et al.*, 1993), the forest industry may want to investigate these matters more fully.

6.6 RELATIONSHIPS BETWEEN DEMOGRAPHIC VARIABLES AND SAFETY ATTITUDES

Age

Table 27 shows that all correlations between age and safety attitude scores were very small ($r < 0.25$). The safety awareness scale was the only attitude scale significantly correlated to age ($r = 0.23$), suggesting that older workers were slightly more aware of safety policies and programmes. This correlation could be accounted for by older workers generally having greater job experience, rather than age itself being the contributing factor.

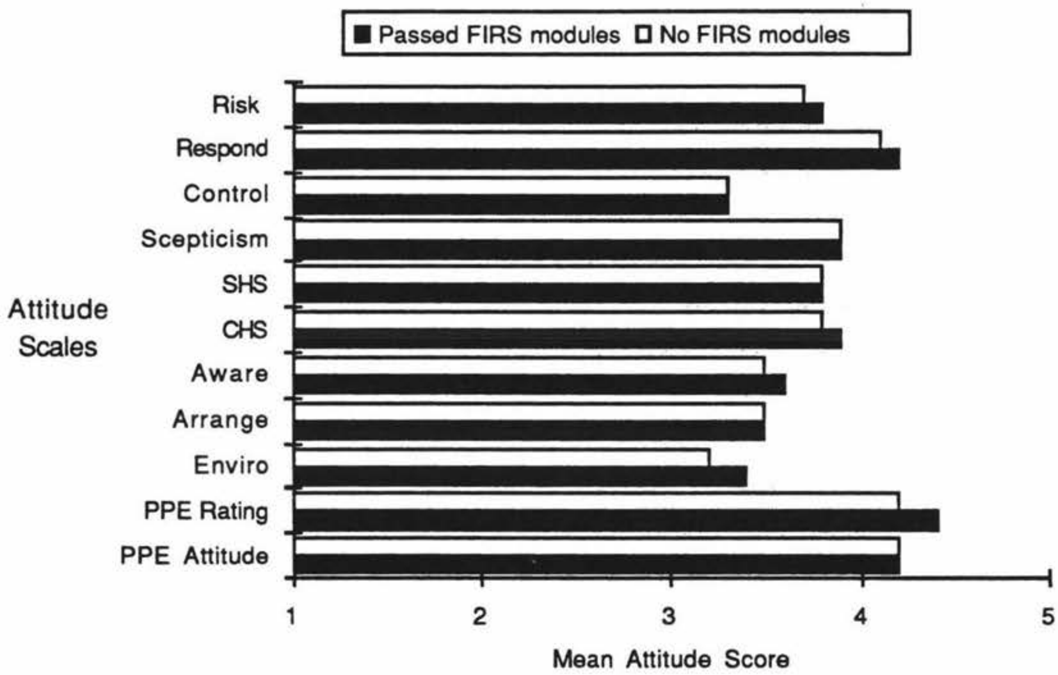
Education

There was no linear relationship between educational qualifications and safety attitudes. However, workers who had spent six years at secondary school had the most negative scores on the following scales: *safety arrangements, locus of control, boss handling of safety,* and *supervisor handling of safety*. They also rated the *work environment* as more annoying. Workers with just one year at secondary school had the highest scores on *safety arrangements, scepticism, locus of control, boss handling of safety,* and *supervisor handling of safety* scales. Workers with just one year at secondary school were generally older and more experienced than the average worker which may have contributed to these differences. However, these results are very difficult to interpret. A tentative explanation is that workers with a higher education may expect more from their boss and supervisor, and are more aware of the deficiencies in the safety arrangements.

Training

The Logging and Forest Industry Training Board (LFITB) recognises trained workers through the Forest Industry Record of Skills (FIRS) Modules. The New Zealand Forest Owners Association (NZFOA) has set a target in their health and safety strategy of having all workers appropriately trained, or undergoing training, by 1996 (NZFOA, 1993b). At the time of this study, only 50% of the work-force had passed some FIRS modules. Considering the high turnover, the forest industry will struggle to meet their target unless some measures are taken to either increase the level of training, reduce turnover, or create a trained labour pool.

Of great interest to many people working within the forest industry is the effect of formal training on safety attitudes. The motto of the Logging and Forestry Industry Training Board is "Attitude is the key", and this is based on the belief that training should give workers a positive safe attitude to their work. This belief is also reflected in the suggestions made by management; this group saw training, education, and a positive attitude as the key to improving safety. Despite the slightly higher scores on virtually all attitude scales for workers who had passed formal FIRS modules (see Figure 15 below), the differences between workers with and without FIRS modules was not statistically significant (see Table 28).



Note: PPE = Personal Protective Equipment
Enviro = Work Environment
Arrange = Safety Arrangements
Aware = Safety Awareness
CHS = Contractor Handling of Safety
SHS = Supervisor Handling of Safety
Control = Locus of Control
Respond = Responsibility Towards Safety
Risk Taking = Attitudes Towards Risk Taking

Figure 15. Mean attitude scores by training

These results suggest that training is not having any major impact on the safety attitudes of the work-force. An exception was the *work environment* scale; workers who had passed FIRS modules found the environmental conditions more annoying. This finding is very difficult to explain. A possibility is that in bad environmental conditions, using recommended work techniques is more difficult than alternative techniques. For example, looking up to make sure there are no broken branches in a tree is more difficult in the rain (due to water in the eyes and poor lighting). Training may increase such activities and as a consequence, bad environmental conditions would be more annoying for those workers with FIRS modules.

Job Experience

Experienced workers appear to be lacking in the forest industry, especially in silviculture. The median number of years spent in a crew was just 1.5 years in silviculture, and 2 years for logging. For job experience, the median was 3 years for silviculture and 6 years for logging. Turnover is a serious problem in forestry. Adams (1993) found a 40% turnover (workers leaving the contractor and company) per year within contract crews working for a logging company. An additional 18% roll-over (workers leaving a contractor but staying within the company) occurred within the crews. A contributing factor to this high turnover and roll-over could be poor safety. In the work-force, 48% reported they would consider leaving their job because of poor safety (see Table 15).

Crew experience was not related to any of the attitude scales. Job experience was significantly related to *safety awareness* ($r = 0.24$) and *locus of control* ($r = 0.24$). These findings suggest that workers with greater experience are slightly more aware of safety policies and programmes, and also feel that they have greater control over their own safety. This finding supports Wichman and Ball (1983) who found that the experience of pilots was positively related to perceptions of internal locus of control and stronger self-serving biases. These increased perceptions of control had a positive effect on safety in that pilots with stronger internal locus of control scores were more likely to attend safety clinics. This result suggests that those people with an external locus of control are harder to reach with regards to safety training as they believe accidents are outside their control, so training will not help them prevent accidents.

General Demographic Variables

Although the relationships between the demographic variables, jobs performed, rest breaks, and working hours were not analysed with respect to attitudes, they do provide some interesting information. A positive finding was the number of crews using job rotation (33% in logging, 49% in silviculture). This type of job design is recommended by Parker and

Cossens (1993) as it can help relieve boredom, which can positively affect log maker performance. Job rotation can also help improve worker vigilance (Krueger, 1991) which could increase safety. However, to be effective job rotation must be combined with training, otherwise lack of skill may become a risk factor.

Working in forestry is very physically demanding (Parker & Kirk, 1994), so it is important that workers have adequate rest breaks during the day to control the build up of fatigue. As workers become more fatigued, their work rate will slow down and they may not be as alert. This can make it difficult to perform the job safely. Many crews (36% logging, 45% silviculture) are opting for just one break during the day, and a third of these crews only stopped work for 30 minutes. Unfortunately, a few crews are not taking any breaks at all. Under these circumstances, the workers' fatigue levels may continue to build up during the work day. Although piece-rate payment systems were more common in silviculture than logging, it is unknown whether the higher number of crews in silviculture not stopping for rest breaks is related to piece-rate payments.

Generally the hours of work seem very high when travel time, hours on the job, and weekend work are all included. These factors could contribute to the high turnover rate, and possibly increase fatigue and accidents.

6.7 ACCIDENTS

Safety research in forestry has generally concentrated on logging accidents on the basis that logging is considered more dangerous, and so it was surprising to find that silviculture workers reported having just as many accidents as logging workers. In both logging and forestry, 16% of the sampled work-force reported having had a lost-time accident in 1992 (company differences are displayed in Appendix F). As this percentage is higher than the estimated 8% annual prevalence rate in logging reported to LIRO's Accident Reporting Scheme (ARS), it highlights the problem of under-reporting to the ARS. It is hard for companies to get all accidents reported as workers may fear punishment from the contractor, contractors may fear the company, and the ACC experience rating system provides an incentive not to report accidents.

Very few near-misses get reported to the ARS, which could be partly due to contractors mis-interpreting the definition of a near-miss. Responses to the question "What do you consider as a near-miss?" produced a wide range of responses, from "close to certain death", to the more common reply of *"injuries* that do not result in lost-time but could have under different circumstances". This understanding differs from the meaning given to the term near-miss in the safety literature. Near-misses are any unplanned events that under slightly different circumstances, *could have resulted in injury*, loss to process, or property damage (Bird & Germaine, 1986). A number of these events were observed while the survey was being conducted and were not considered important by the workers.

Although it would be useful to know all the incidents (near-misses and accidents) that occur, under-reporting itself does not have a negative impact on safety. Guastello (1993) found that concentrating on accident reports and near-misses was not a successful method of reducing accidents, and Kletz (1993) stated that lost-time accidents do not always explain why the accidents are happening. Furthermore, the causes of accidents are usually present before an accident occurs. Accident investigations are a reactive method of trying to reduce accidents, as the accident has already occurred.

Logging accidents resulted in a mean of 33 days off work and a median of 6.5 days. This mean is much higher than the ARS figure of 10.4 ± 2.1 days (Parker, 1993a). However it is distorted because of one accident causing 1 year off work. The mean for silviculture was 15 days which is also much higher than the 5.8 days reported by Parker (1993b). Parker's figure is closer to the silviculture median of 4 days. These figures suggest that logging accidents are generally more severe than silviculture accidents.

The majority of accidents (50% logging, 67% silviculture) result in one week or less off work, and do not require hospitalisation (29% logging, 79% silviculture - see Table 29). As a consequence, many of these accidents would not be recorded by the Accident Compensation Corporation claims database, so people interested in forest safety may be unaware of the high number of minor injuries.

Accident Involvement and Demographic Variables

In this study, education, ethnic origin, and crew experience were not related to accident involvement. Cohen *et al.* (1979) and Simonds and Shafai-

Sahrai (1977) noted that having an experienced work-force and low turnover is an advantage in terms of safety and productivity. Inexperience is often mentioned as a cause of accidents, however there is still a lack of research to support this claim. Some studies have found injury rates higher among loggers with less than a year of experience (Klen, 1988), while others such as Kawachi *et al.* (1991) have found a lower injury rate among New Zealand loggers with less than one year experience. This study found no relationship between job experience and accidents.

Previous studies have found the method of payment was associated with a higher accident rate (Ekstrom, 1981; Pettersson *et al.*, 1983). Pettersson *et al.* (1983) reported a 32% drop in accidents when the payment method was changed from piece-work to salary. However, this was accompanied by a 28% drop in production. No relationship was found between payment methods and accidents in this study.

Age was negatively related to accident involvement with the mean age of workers who had an accident in 1992 (M = 25.8) being significantly lower than workers who had not (M = 28.9). This finding is in contrast to those reported by the International Labour Organisation (1981) which suggest greater age is associated with more injuries. In a New Zealand epidemiological study by Kawachi *et al.* (1991), no relationship between accident involvement and the age of the victim was evident.

It is assumed that training enables work to be conducted in a safe, efficient and productive manner. Probine, Grayburn, and Cooper (1987) emphasise the need for a well trained work-force because virtually all forest operations are potentially dangerous. Training workers can also have other benefits such as reducing turnover (Adams, 1993). To examine whether training was related to accidents, a comparison was made between the passing of FIRS modules and accidents. A significant relationship was found; the workers who had passed FIRS modules were involved in more accidents ($p = 0.05$). There was also a significant relationship ($p < 0.05$) between working towards FIRS modules and accident involvement. Those working towards FIRS modules had been involved in more accidents.

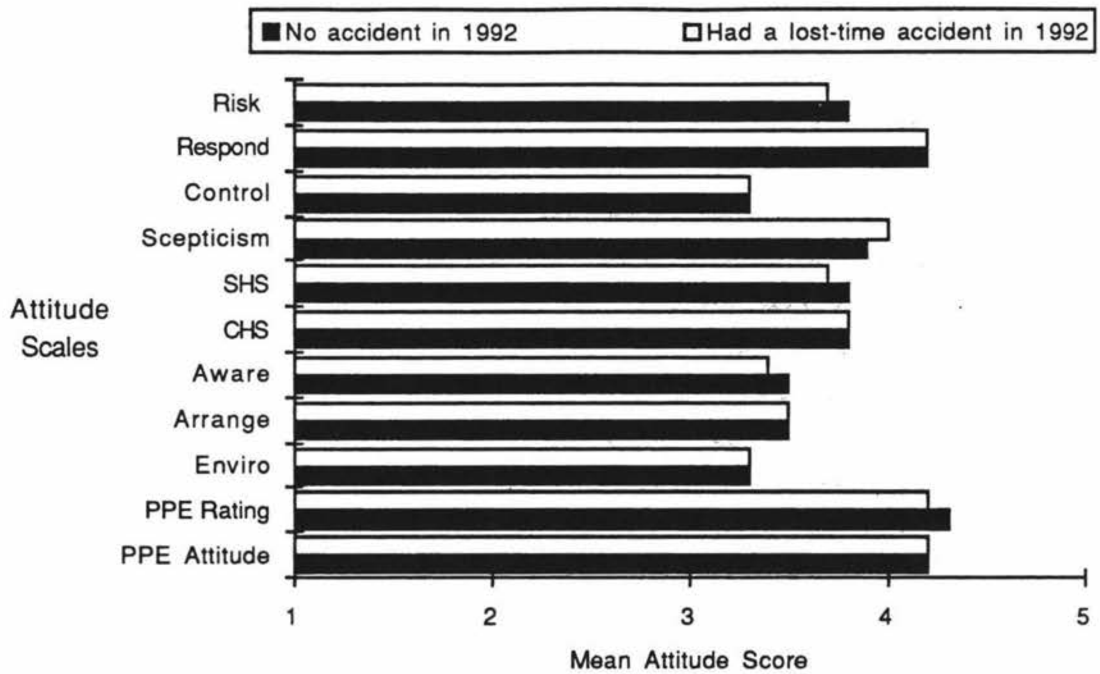
This is an unusual finding, as increasing training is the most recommended method for improving safety (see Table 21). These unexpected results do not prove that FIRS training is ineffective at preventing accidents as the results may be an artifact of the survey method used. Some workers may not have passed any FIRS modules at the time of the accident, but may have undergone training between the time of the accident and the time of the survey. Workers were asked whether they had an accident in 1992, and were asked if they had passed any FIRS modules in June 1993. This gives workers 6 to 18 months between the time of the accident and the survey, which is plenty of time to pass some FIRS modules.

Another possible explanation is that involvement in an accident could motivate some workers to do FIRS modules. This might explain why workers currently working towards FIRS modules have had more accidents (see section 5.10). Also, some trained workers could have been victims of an untrained worker's mistake (the reverse could also apply). Finally, the criteria for training used in the survey were limited to FIRS modules. Some workers without FIRS modules may have undergone other forms of training such as forestry polytechnic courses.

These reasons are plausible and cast doubt on a conclusion that FIRS training contributes to accidents. The important thing to note is that, although the majority of people involved in the industry are emphasising the need for more training of workers, simply training workers to current FIRS standards is unlikely to eliminate accidents. If FIRS training could reduce the majority of accidents, there would have been some positive relationship despite the problems mentioned. These results indicate that accidents cannot be attributed to lack of experience, education, or training. The problem appears far more complicated.

Accident Involvement and Attitudes

There was no significant difference between the safety attitudes of workers who were involved in an accident in 1992, and workers who were not, on any of the attitude scales (see Table 30). This finding is displayed more clearly in Figure 16 below. This finding supports the fourth hypothesis that "Safety attitudes will be unrelated to accident involvement".



Note:: PPE = Personal Protective Equipment
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Figure 16. Mean attitude scores by accident involvement.

This result is similar to that of Murphy (1981) who found the attitudes of farmers who had accidents were very similar to those who had not. The findings of this study do not support the concept of "accident proneness" as individual attitudes and demographic characteristics were not related to accidents.

Despite a lack of research supporting the concept of accident proneness, it is still advocated by a number of researchers. Stinnett (1990) states that workers lack of awareness, poor attitudes, and accident proneness traits are a probable cause of accidents, yet no research is cited to back these claims except Stinnett's personal experiences. It is the author's opinion that such articles may make it difficult for safety practitioners to convince the general public and management to look beyond the individual as a cause of accidents.

There are a number of possible explanations why no relationship was present between attitudes and accident involvement in this study. The first is that attitudes may change after an accident. Accidents in forestry can be very severe so if a worker had poor attitudes before an accident, they could have a sudden change of heart regarding their attitudes towards safety. Secondly, workers with positive attitudes may be victims of accidents that were caused by people with poor safety attitudes (once again, the reverse is also plausible). Thirdly, expressed attitudes may not influence behaviour, which is very probable according to the literature on attitude-behaviour consistency (Wicker, 1969).

Observations made by the author during the survey support the third explanation that attitudes may not have a strong influence on behaviour. Many contractors and workers stated they were very concerned about safety and appeared to have a good safety attitude. However, they were then observed using work techniques considered unsafe by industry standards. The opposite situation occurred with workers who displayed a poor attitude toward safety. For example, one worker stated that personal protective equipment was "useless" because his co-worker had cut straight through a pair of steel-capped boots. This particular worker was also very sceptical about the value of safety. Although this worker had a poor attitude towards PPE (despite his comments being fair in that PPE cannot actually stop a chain-saw) he still acted very safely because he did not want to be an accident victim. It appears that workers will do *their* best to avoid an accident regardless of whether they display a positive or negative attitude towards safety. Nobody wants to suffer a severe injury or fatality.

Attitudes Towards Accident Investigations

The majority of workers who had an accident in 1992 were not very concerned about accident investigation practices with most stating that they were happy with the investigation (see Table 32). However, it appears that accident investigations in 1992 did not have very good follow-up procedures. In theory, after an accident, the crew (and company) should get together to see how the accident occurred and how it can be avoided in the future. This happened in only 24% of the accidents and, in the majority of accidents (65%), workers did not receive any assistance to help them recover and re-enter the work-force.

These results identify two major weaknesses with current follow-up procedures: a lack of follow-up, and a lack of rehabilitation. Follow-up procedures are necessary to ensure that recommendations to prevent the accident happening again in the future are carried out and evaluated for effectiveness. Rehabilitation is also essential as re-occurring injuries, such as back pain, can be prevented (Väyrynen & Kononen, 1991). Effective rehabilitation programmes can lead to an early return to work, and reduce the number of accidents (Asma, Hilker, Shevlin, & Golden, 1980).

Another serious problem with current forest accident investigations is that the recommendations are not preventing the same accident occurring again in the future. Evidence of this can be seen in the New Zealand Logging Accident Reporting Scheme and the Occupational Safety and Health Service's bush bulletins. Similar accidents are occurring over and over again. For example, slipping and chain-saw cuts to the feet while delimbing continue to account for a large proportion of injuries. A possible reason for recommendations not preventing similar accidents happening again in the future is the attributional errors discussed earlier in this chapter. The results from the survey (see Tables 15 and 21) suggest the emphasis is being placed on the worker as the cause of accidents. Accident report summaries viewed by the author also suggest that carelessness and lack of attention are frequently cited as the main cause in many accidents.

However, results from the survey suggest that individual characteristics such as training, education, experience, and attitudes are not associated with accident involvement. Research examining safety programmes (described in Chapter 3) noted that concentrating on the individual is a relatively ineffective method of reducing accidents (Guastello, 1993), and Kletz (1993) noted the worst thing a person can do in accident investigations is tell people to be more careful, as this is blaming the individual and accepting the hazards. Related research suggests that individuals tend to over-estimate dispositional influences and under-estimate situational influences when describing the behaviour of others (Ross, 1977). Modern theories of accident causation stress how the decisions of management can lead to accidents. These factors lead the author to believe that there are serious deficiencies in present accident investigations which may be caused by attributional biases.

A possible cause of accidents was noted by the author during the induction phase and the attitude survey. It appears that many accidents that occur in the forest industry are related to the problem of vigilance. Vigilance tasks require constant monitoring and attention to be performed effectively. In logging, workers need to watch where they step, what is above them, happening around them, as well as concentrate on their chain-saw. The environment has to be continuously monitored for hazards as missing a single broken branch could result in injury. Due to limitations of human sensory capacities, individuals are not capable of noticing everything. Mackworth (1948) found that people make a high number of errors even in simple monitoring tasks, demonstrating the difficulty of maintaining vigilance.

Current accident investigations could be improved by being aware of the difficulties involved in vigilance tasks, the biases that are present when attributing responsibility, and incorporating proper follow-up investigations and rehabilitation. New accident investigation procedures such as group routines (Carter & Menckel, 1990) could also be applied to improve investigation effectiveness.

CHAPTER 7 - CONCLUSION

This study found positive attitudes towards safety among company management and the work-force, however perceptions of management commitment to safety were poor. Attitudes towards safety hardware were very good with both management and the work-force scoring highly on the PPE *attitude* and *PPE rating scales.* Attitudes towards safety software were not so positive with management and the work-force rating *safety arrangements* rather poorly. Workers' scores on the *safety awareness* scale were also low. This indicates that many workers were unaware of the Health and Safety in Employment Act (1992), safety policies, and safety programmes. With regards to people, everybody had positive attitudes towards *responsibility.* Contractors and managers had good attitudes towards the value of safety, however supervisors and workers expressed some scepticism about the value of safety. *Locus of control* scores indicated that the work-force did not tend towards and internal nor an external locus of control, with most scores in the middle of the scale. Workers generally rated *contractor and supervisor handling of safety* as reasonable, but there was plenty of room for improvement in the scores. Finally, although attitudes towards risk taking were reasonably positive, knowledge of objective risk was poor.

A number of important findings of this study are listed below.

- There were significant differences between the attitudes of logging and silviculture workers, and also between the attitudes of contractors and workers.
- FIRS training was not related to attitudes, nor reduced accident involvement.
- Knowledge of safety goals and policies was very low.
- In both silviculture and logging, 16% of workers had a lost-time accident in 1992.
- Individual attitudes and demographic characteristics were not related to accidents.
- There appears to be little follow-up investigation after accidents, nor any rehabilitation.
- Management generally attributed the cause of accidents to individual characteristics such as lack of training. The work-

force attributed accidents to more external factors, such as pressure to produce.

- Attribution errors could be causing deficiencies in current accident investigations.

Despite no relationship being found between attitudes and accidents, studying safety attitudes is still very useful when examined at the organisation level. This study provides the forest industry with valuable information regarding the safety climate, individual attitudes, and accident investigations. How these findings can be used to improve safety in the forest industry is discussed in the following recommendations.

7.1 RECOMMENDATIONS

For the Forest Industry Safety Strategy

The importance of management commitment has been emphasised by studies examining safety climate (Zohar, 1980; Brown & Holmes, 1986; Dedobbeleer & Béland, 1991), accident causation (Dejoy, 1990; Wagenaar *et al.*, 1990), and factors related to successful company safety (Cohen et al., 1975; Simonds & Shafai-Sahrai, 1977). This study indicates that this commitment is lacking in the New Zealand forest industry. Although management reported that they are committed to safety, they freely admit that the work-force will not believe that they are committed, and that there is conflict between safety and other job demands. If management were truly committed to safety, they would have addressed the problem of conflicting job demands and the negative safety climate.

To improve safety in the forest industry, management must create a positive safety climate by demonstrating their commitment. An extensive education and training programme is required to show management how this can be achieved. Risk communication should also be focused on management to demonstrate how risks can be developed or removed through the decisions of management (Wagenaar *et al.*, 1990). Griffith (1985) stated that senior management must have a positive approach to controlling safety in the same way as it controls production, quality, costs and sales, if the number of accidents is to be significantly reduced.

Once management have created the climate for improving safety, extensive behavioural modification and comprehensive ergonomic programmes need to be implemented. Every operation must be examined and even though the operation might appear to work well, the question should be asked, can it operate in a safer way? Company management, contractors and workers need to be involved in this task. Guastello (1993) found behavioural modification and comprehensive ergonomics to be the most effective techniques for reducing accidents.

To improve safety, training of workers must be effective. This study suggests that current FIRS training may not be as effective at improving safety as previously believed. Training programmes need to be evaluated to measure their effectiveness. There are a few basic principles recommended by Cohen *et al.* (1979) which should increase the effectiveness of training. The learning of safe behaviour should be stressed rather than the unlearning of unsafe behaviour. The benefits of safe behaviour should be promoted, and reinforcement should be used for encouragement. Positive reinforcers are generally more effective than negative reinforcers. The best and cheapest form of reinforcement is immediate feedback. As mentioned earlier, goal setting is a very powerful technique for improving behaviour (Reber *et al.*, 1990). Despite the importance of training, it must be remembered that people will make errors (vigilance problem), so tasks need to be redesigned to allow for error without injury.

When trying to change attitudes, there are a number of useful methods that were discussed in Chapter 2 that may help persuade the audience. These methods should be used in conjunction with behavioural modification programmes.

- Use credible sources to sell the messages (trustworthy experts in the field).
- Sources who are liked and are similar to the audience are also more persuasive.
- Present information that is not totally different from present views.
- Present strong arguments.
- Increase the perceived risk to a moderate level.
- Demonstrate how the new message will remove the risk.
- The spoken word has more persuasive impact than the written word.

- Informal face-to-face communication is superior to any media transmission.
- Repeat the persuasive campaigns.

Further improvements to safety could be made by following recommended accident investigation procedures that are based upon modern theories of accident causation. The findings of this study indicate that present accident investigation procedures may be suffering from attributional biases. Educating the industry on modern theories of accident causation and attributional errors should improve the effectiveness of these accident investigations. Follow-up investigations and rehabilitation programmes also need to be included.

Finally, applying the principles of Total Quality Management (TQM) to safety is also highly recommended by modern safety practitioners (Mitchell, 1993; Smith, 1993). The forest industry should engage in activities such as "bench-marking". They need to examine the programmes and safety systems being used by successful safety companies and apply these systems in their own industry.

Future Research

Relatively little attention has been given to the mental workload or the problem of vigilance in forestry. These areas need to be examined if a better understanding of why accidents occur is desired. This work is required not only in logging but also in silviculture, as the latter group has been neglected in past safety research.

Training in forestry needs to be evaluated for its effectiveness in reducing accidents. Results suggest that current FIRS training may not be as effective in relation to safety as is believed. A long-term programme evaluation is required to monitor and improve current training practices. This work has also been initiated by the Logging Industry Research Organisation.

Research needs to investigate possible methods for reducing turnover. Current turnover rates will make it difficult to achieve a highly trained and effective work-force.

Research is also required which explores how work tasks can be ergonomically redesigned to remove the level of risk faced by the workers. Mechanisation of more forest operations may help achieve this.

To improve safety in forestry is not an easy task. Forest accidents are a major problem both in New Zealand and internationally. This study highlights the difficulty faced by the forest industry in trying to improve safety, as accidents are not due simply to poor attitudes, lack of experience, nor inadequate training. The importance of management has been emphasised throughout this study because the recent safety literature indicates that management can have the greatest impact on efforts to improve safety. For example, even if accidents were related to a lack of training, it is management who are in the best position to address this problem at an organisation or industry level. Currently, the forest industry is taking many steps in the right direction to improve safety, with the development of the NZFOA safety strategy. This study identifies a number of problem areas that, if addressed, should help to improve the level of safety in this industry.

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APPENDIX A - GLOSSARY OF TERMS

BELL LOGGER A versatile 3 wheel logging machine that can fell, bunch, extract, sort and load logs and roundwood. Different accessories can be fitted to facilitate the function required.

BREAKER-OUT Worker at the felling site responsible for connecting trees or logs to a hauling rope, tractor, skidder, etc., for transport to a landing.

BUSH INSPECTOR Officer of the Department of Labour responsible for ensuring compliance with the Health and Safety in Employment Act 1992.

BUSHMAN Person who works in the bush (forest), especially on logging operations.

CABLE LOGGING Any hauling system employing a stationery machine with powered drum(s), spars, blocks, wire rope and butt rigging to haul logs from the felling sit to an assembly point or landing.

CHAINBRAKE A safety device on a chainsaw designed to stop the chain in event of "kickback".

CHAINSAW A powered saw where the cutting action is performed by a series of linked teeth interspersed with depth gauges which travel around a guide bar.

CHAPS Leggings designed to protect legs from chainsaw cuts.

CREW A complete team of men needed to work one logging operation.

CUTOVER Clearfelled area of forest.

DELIMB To remove limbs or branches from a tree or log.

DELIMBER A device or machine designed to remove limbs from trees.

FALLER One who fells trees.

FELL To sever a standing tree from its stump and bring it to the ground.

FELLING Act of cutting down trees.

HANG UP
(i) In felling, a tree caught in or against another, thus preventing it from falling to the ground:
(ii) In skidding or hauling, to get a drag stuck in the mud or caught behind some obstacle.

HAULER
(i) General term for machine to haul trees or logs;
(ii) In cable logging, a machine equipped with winches which operates from a set position to haul drags from stump to landing.

LANDING A selected or prepared area to which logs are extracted and where they may be sorted, processed, loaded or stockpiled.

LOADER Machine designed to load, stack and sort logs or tree-lengths of which there are many types, both track and wheel mounted.

LOG Stem, or length of stem, of a tree after felling or crosscutting, often used with descriptive adjectives such as first, second, third, etc. (counted fro the butt), Butt, top, saw, peeler, veneer, pulp. To harvest (extract) trees or logs from a forest.

LOGGER One engaged in harvesting timber.

LOGGING Harvesting timber from a forest, often used with descriptive adjectives such as full-tree, hot, integrated, selective, pulpwood, tree-length, etc.

MOTOR-MANUAL Refers to work carried out by hand-held power tools.

PROTECTIVE TROUSERS Safety trousers with ankle to groin protective padding for chainsaw operators.

SAFETY BOOTS Working boots fitted with steel toecaps.

SAFETY HELMET Headgear designed to protect the wearer's head.

SAFETY MITT A leather glove attached to the front handle of a chainsaw.

SAILER A broken limb or tree crown hanging precariously, which could fall on workers below it.

SILVICULTURE Literally "the culture of woods." Term used for growing and tending forest crops: includes establishment, tending (pruning, thinning, fertilising, etc) and harvesting.

SKIDDER A self-propelled extraction machine with wheels or tracks specifically designed to partly support logs during skidding.

SLASH Branches, bark, tops, chunks, cull logs, uprooted stumps and broken trees left on the ground after logging.

SPIKED BOOTS* Safety boots with spikes attached to the soles of the boot to improve grip.

WINDTHROW Area of trees blown down by the wind.

Note: These definitions (with the exception of those marked with a *) are from Spiers (1985) Loggers' Language. A New Zealand Terminology.

APPENDIX B - ATTITUDE QUESTIONS

The following questions were chosen and reworded, then used in the safety attitude questionnaire.

Cox and Cox (1991):
Safety equipment should always be worn when needed.
Even experienced people need to be reminded about safety. The risks in their jobs still exists.
If I worried about safety all the time I would not get my job done.
There is less chance of having an accident at work than there is of having an accident when doing jobs at home.
I should encourage my colleagues to work safely.
Accidents only happen to other people. I am a safe worker.
There is no point in reporting a near miss.
Not all accidents are preventable, some people are just unlucky.

Sherry (1991):
Does your supervisor set safety goals?
Are current safety programmes effective?
Is getting injured a matter of luck?
Are you to busy to worry about safety?
Do you enjoy taking risks?
Are you satisfied with your on the job safety training?
Have you been bothered by back pain?
Do you feel conflict between safety and other job demands?

Dedobbeleer and Béland (1991):
How much do supervisors and other top management seem to care about your safety?

They do as much as possible to make the job safe.
They are concerned about safety but they could do more than they are doing to make the job safe.
They are really only interested in getting the job done as fast and cheaply as possible.

Melamed *et al.* (1989)
An environmental annoyance scale was created which was based upon Melamed *et al.*'s work environment scale.

Leather (1988):
Above all else, individual carelessness is the major cause of construction accidents.

Rotter (1966):
What happens to me is my own doing.
Many times I feel I have little influence over the things that happen to me.

APPENDIX C - PILOT TESTING

The following questions were removed after pilot testing the questionnaire.

I find logging work easy.
Do you get recognition for performing your job safely?
Do you get clear directions about the importance of safety?
Safety is just a matter of people taking a little more care and thinking about what they are doing.
Doing the job quickly is more important than safety.
Acting safely is costly and time consuming.
I have confidence in my boss.
I have confidence in my supervisor.
Safety in logging is improving.
I am happy with the level of safety in my job.
The boss does not mind me stopping for a minute when I'm tired.
Logging work is safe.
Risks cannot be avoided in logging.
I will probably have an accident this year.

APPENDIX D - THE QUESTIONNAIRES

There were two copies of the 'worker' questionnaire: logging and silviculture. The words 'logging' and 'silviculture' were used in the appropriate logging or silviculture questionnaire. The choice of jobs (Q10) was also altered to the target population.

Contractor questionnaires had a few additional questions that were not in the worker questionnaire. These questions related to crew rest breaks, payment methods, and accidents. Questions that referred to 'the boss' in the workers' questionnaire were changed to 'I' so they referred to the contractor completing the questionnaire.

The supervisor questionnaire was almost identical to the manager questionnaire. The essential difference was the words 'manager' and 'supervisor' were interchanged.

(Worker)

Attitudes Towards Safety Questionnaire

The purpose of this questionnaire is to find out what your views to safety are and how these views are related to other items like training and education. The results will be used to try to improve safety in your job. The contents of this form are **completely confidential. Your contractor, supervisor and company will not see your answers.**

Please circle your answer or reply in the space provided.

Name? (optional) ____________________

(1) Age? (in years) ____________

(2) Sex? Male
Female

(3) Race? NZ European
NZ Maori
Other (specify)____________

(4) How many days did you spend training with the following groups in 1992?

Please tick the appropriate boxes

	0	less than one	1 to 3	4 to 7	8 to 14	15 or more
(i) Your Boss?						
(ii) Another worker?						
(iii) Company Trainers?						
(iv) L&FITB?						
(v) Polytech?						
(vi) Other (specify)						

(5) Have you passed any FIRS Modules? Yes No

(6) Are you currently working towards or doing any:
(i) FIRS Modules Yes No
(ii) Polytech courses Yes No
(iii) Other (specify) ____________

(7) How many years did you spend at High School?
0 1 2 3 4 5 6

(8) How many years of work experience do you have:
(i) In silviculture? ____________
(ii) In logging? ____________

(9) Do you have :	Yes	No	Don't know
(i) School Certificate?			
(ii) U.E ?			
(iii) H.S.C ?			
(iv) A Trade Certificate ?			
(v) A Diploma ?			
(vi) A Degree ?			
(vii) Other educational qualification? (specify)			

(10) What do you spend most of your time doing?

Felling
Breaking out
Skidwork
Tractor Op.
Hauler Op.
Other ________
Trimming
Log making
Skidder Op.
Loader Op.
Job sharing (felling, skidwork, etc)

(11) How long have you been doing the job above? ________

(12) How long have you worked in this crew? (years) ________

(13) What time do you usually:

(i) Leave for work? ________

(ii) Arrive home? ________

(14) How long does it take you to travel to work (one way)? ________

(15) How often do you work in logging on weekends? (please circle)

Never | few times a year | once a month | 2 or 3 times a month | every weekend

(16) How often do the following people <u>talk to you</u> about safety?	Daily	Weekly	Monthly	Yearly	Never
(i) Your boss					
(ii) Your supervisor					
(iii) The bush inspector					
(iv) A trainer					

(17) How annoying would you rate the following in your job?

	Does not annoy me at all	Not too bad	Slightly annoying	Annoying	Very annoying
(i) Noise					
(ii) Heat					
(iii) Cold					
(iv) Weather (rain, wind)					
(v) Dust					
(vi) Mud					
(vii) Fumes (eg. smoke)					
(viii) Weeds (gorse, blackberry)					
(ix) Vibration					

(18) How much do you think the following items help reduce injuries?

	No help at all	Very little help	Does help a bit	Pretty helpful	Very helpful
(i) Helmets					
(ii) Visors					
(iii) Chaps					
(iv) Chainsaw trousers					
(v) Earmuffs					
(vi) Steel capped boots					
(vii) Spiked boots					
(viii) Cut resistant rubber boots					
(ix) High visibility gear					
(x) Chainsaw mitt					
(xi) Seatbelts					
(xii) Chainbrake					

(19) Have you heard of the Health and Safety in Employment Act?
No Yes - Do you understand your responsibilities under the new act?
(a) No
(b) I'm not sure
(c) Yes

(20) Have you seen your gangs safety policy?
No Yes - Do you understand it?
(a) No
(b) I'm not sure
(c) Yes

(21) Have you seen the company safety policy?
No Yes - Do you understand it?
(a) No
(b) I'm not sure
(c) Yes

(22) Have you seen the Forest Owners Association safety policy?
No Yes - Do you understand it?
(a) No
(b) I'm not sure
(c) Yes

(23) Please circle the number of people you think were killed in logging accidents in NZ for 1992. (Guess if not sure)
1 3 5 7 9 11 13

(24) How many logging accidents (resulting in time off work) do you think were reported in NZ for 1992?
(a) 50 to 99
(b) 100 to 149
(c) 150 to 199
(d) 200 to 249
(e) 250 to 300

(25) How strict are each of the following in enforcing safety?

	Very strict	Strict	Fairly strict	A little strict	Not strict at all
(i) Your boss					
(ii) Your supervisor					
(iii) The bush inspector					
(iv) The trainers					

Could you please read the following statements then tick the box to show whether you agree or disagree with the statement.

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
(26) Working in logging is very hard physical work.					
(27) Working in logging you need to keep your mind on the job.					
(28) My work can be very stressful at times.					
(29) I have control over the speed at which I work.					
(30) It is important to wear safety equipment at all times while at work.					
(31) I would wear the safety gear I wear now even if it was not compulsory.					
(32) There would be less accidents if there was no protective gear because people would be more careful.					
(33) Most of the safety gear is useless at preventing injuries.					
(34) The boss checks that we wear the required gear when working.					
(35) The supervisor checks that we wear the required gear when working.					
(36) Logging is very dangerous work.					
(37) There is nothing in the job that forces you to take risks.					
(38) I enjoy taking chances.					
(39) Taking risks is part of logging.					
(40) I am more likely to have an accident at home than at work.					
(41) The boss handles safety problems well.					
(42) The supervisor handles safety problems well.					
(43) Production pressure has no effect on safety.					

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
(44) My on-the-job safety training was excellent.					
(45) Safety programmes are very important.					
(46) All injuries are preventable.					
(47) Getting injured is usually just bad luck.					
(48) I'm too busy to worry about safety.					
(49) An accident won't happen to me.					
(50) There is no point in reporting a near miss.					
(51) Even experienced people need to be reminded about safety.					
(52) Accidents happen because workers are too careless.					
(53) I feel that I have little control over the things that happen to me at work.					
(54) If I worried about safety all the time I would not get my job done.					
(55) Good drivers don't need to wear seatbelts.					
(56) Acting safely is respected by my workmates.					
(57) Everybody shares the responsibility for safety.					
(58) All accidents can be avoided.					
(59) I can look after my own personal safety.					
(60) I have a lot of involvement in safety decisions.					
(61) People who do not follow safety rules endanger themselves and their workmates.					
(62) There is conflict between safety and other job demands.					
(63) What happens to me at work is my own doing.					

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
(64) I would consider leaving the job because of poor safety.					
(65) The logging industry does all that it possibly can to ensure that workers are safe.					
(66) I know how to approach the boss about my safety concerns.					

	Yes	No	Don't know
(67) Are you aware of any safety programmes operating in your forest (eg. safety meetings, safety incentive schemes)?			
(68) If yes, do you think current safety programmes are very effective?			
(69) Do you have regular safety meetings?			
(70) Does your <u>boss</u> set safety goals?			
(71) Does your <u>supervisor</u> set safety goals?			

(72) Safety is more important than profits, production and quality.

	Yes	No	Don't know
(i) Do you think your <u>boss</u> really believes this?			
(ii) Do you think your <u>supervisor</u> really believes this?			
(iii) Do you think your <u>workmates</u> really believe this?			

(73) Which statement below (1,2 or 3) best describes how much your boss cares about your safety? ________

(1) Does as much as possible to make the job safe.
(2) Is concerned about safety but could be doing more to make the job safe.
(3) Is really only interested in getting the job done as fast and cheaply as possible.

(74) Which of the above statements (1,2 or 3) best describes how much your supervisor cares about your safety? ________

(75) Overall, how would you rate the following in their attitude towards safety?

	Doesn't care	Bit slack	Alright	Good	Excellent
(i) Your boss					
(ii) Your supervisor					
(iii) The trainers					
(iv) Your workmates					
(v) The bush inspector					
(vi) Your own					

(76) How do you think safety could be improved and accidents reduced in your job?

____
____
____
____
____
____

(77) Have you ever suffered from back pain?
No Yes

(78) Have you had an accident at work in the last five years which resulted in an injury that caused you to take more than a day off work?
No
Yes - Did this accident happen last year (1992).
No
Yes - How many lost time injuries did you have last year?
1 2 3 4

Please complete this page only if you had an accident last year.

(79) What job were you doing at the time of the accident? (Please describe the worst accident if you had more than one) ____________

(80) How did the accident happen?

____

____

____

(81) How long were you off work? (in days) ____________

(82) Did you go to hospital?
No Yes - How many days did you spend in hospital?________

(83) Did any of the following talk to you about the accident? (please circle)
Contractor Supervisor Bush Inspector Trainer
Other (specify) ____________

(84) Can you remember the advice that you were given from anybody?

____

____

____

____

(85) Did anyone come back later to check that the recommendations or advice was followed?
Yes No Don't know

(86) What do you think was the main cause of the accident?

____

____

____

____

(87) After the accident did the gang get together to see how it happened and how it can be avoided?
Yes No Don't know

(88) Did anybody assist your recovery and entry back to the workforce?
Yes No Don't know

(89) How happy were you with the investigation that took place after your accident and the advice given?

Very unhappy	unhappy		happy	Very happy
1	2	3	4	5

Attitudes Towards Safety Questionnaire (Manager)

The purpose of this questionnaire is to find what your and your companies views towards safety are. These will be compared to contractors and workers. It also asks information on current safety procedures. The effect of these attitudes and programmes on accidents will be examined. **All information will remain completely confidential.**

Please circle your answer or reply in the space provided.

Name? (optional) ______________________

(1) Age? (in years) ______________

(2) Sex?
Male
Female

(3) Race?
NZ European
NZ Maori
Other (specify)________________

(4) How many years work experience do you have:
(i) In forestry? ____________
(ii) In logging? ____________

(5) How many years did you spend at High School?
0 1 2 3 4 5 6

(6) Which statement below (1,2 or 3) best describes how much you care about worker safety? ________

(1) I do/does as much as possible to make the job safe.
(2) I am/is concerned about safety but could do more than they are doing to make the job safe.
(3) I am/is really only interested in getting the job done as fast and cheaply as possible.

(7) Which of the above statements (1,2 or 3) best describes how much your company cares about worker safety? ________

(8) Do you have :	Yes	No
(i) School Certificate?		
(ii) U.E ?		
(iii) H.S.C ?		
(iv) A Trade Certificate ?		
(v) A Diploma ?		
(vi) A Degree ?		
(vii) Other educational qualification? (specify)		

(9) How often do each of the following talk to workers and contractors about safety?	Daily	Weekly	Monthly	Yearly	Never
(i) Your supervisors					
(ii) Your trainers					
(iii) Yourself					

Could you please read the following statements then tick the box to show whether you agree or disagree with the statement.	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
(10) Safety is a line management responsibility.					
(11) Safety is a condition of employment.					
(12) Management is responsible for the safety of its employees.					
(13) Working longer hours increases the chance of an accident.					
(14) Working in forestry is very hard physical work.					
(15) Working in forestry you need to keep your mind on the job.					
(16) Forestry work can be very stressful at times.					

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
(17) Workers have control over the speed at which they work.					
(18) It is important to wear safety equipment at all times while at work.					
(19) There would be less accidents if there was no protective gear because people would be more careful.					
(20) Most of the safety gear is <u>useless</u> at preventing injuries.					
(21) The <u>supervisor</u> checks that workers wear the required gear when working.					
(22) Working in forestry is very dangerous.					
(23) There is nothing in the job that forces. workers to take risks.					
(24) The <u>company</u> handles safety problems well.					
(25) Workers are more likely to have an accident at home than at work.					
(26) Taking risks is part of logging.					
(27) I handle safety problems well.					
(28) Production pressure has no effect on safety.					
(29) Safety programmes are very important.					
(30) All injuries are preventable.					
(31) Getting injured is usually just bad luck.					
(32) I'm too busy to worry about safety.					
(33) There is no point in reporting a near miss.					
(34) Even experienced people need to be reminded about safety.					
(35) Accidents happen because workers are too careless.					
(36) If I worried about safety all the time I would not get my job done.					
(37) Good drivers don't need to wear seatbelts.					

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
(38) Acting safely is respected by workers.					
(39) Everybody shares the responsibility for safety.					
(40) All accidents can be avoided.					
(41) I have a lot of involvement in safety decisions.					
(42) People who do not follow safety rules endanger themselves and their workmates					
(43) There is conflict between safety and other job demands.					
(44) Workers would consider leaving the job because of poor safety					
(45) The forest industry does all that it possibly can to ensure that workers are safe.					
(46) Supervisors know how to approach their managers about their safety concerns.					

	Yes	No	Don't know
(47) Do you have regular safety meetings?			
(48) Does your company conduct safety audits?			
(49) Are safety and health rules understood by all workers?			
(50) Do you have Material Safety Data Sheets for all hazardous products?			
(51) Does your company have an emergency plan established in the forest?			
(52) Do you get contractors to practice emergency drills?			
(53) Does the company set safety goals?			
(54) Who has input in setting company safety goals? (please specify)			

(55) Have you heard of the Health and Safety in Employment Act?
No Yes - Do you understand your responsibilities under the new act?
(a) No
(b) I'm not sure
(c) Yes

(56) Do your contractors have their own safety policy?
(a) No
(b) I'm not sure
(c) Yes

(57) Have you seen the company safety policy?
No Yes - Do you understand it?
(a) No
(b) I'm not sure
(c) Yes

(58) Have your contractors seen the company safety policy?
No Yes - Do they understand it?
(a) No
(b) I'm not sure
(c) Yes

(59) Have the workers seen the company safety policy?
No Yes - Do they understand it?
(a) No
(b) I'm not sure
(c) Yes

(60) Were contractors and workers involved in constructing the safety policy?
No Yes

(61) Do you follow the Forest Owners Association safety policy?
No Yes - Have the contractors seen it?
(a) No
(b) I'm not sure
(c) Yes

(62) Who is responsible for conducting an accident investigation?

____

(63) What training have investigators completed?

____

____

(64) What information is collected after an accident?

___

___

___

___

___

(65) What is considered to be a near miss? Do contractors report these?

___

___

___

___

(66) What people in the company receive an accident report?

___

___

(67) Is there any follow up procedures to check whether recommendations have been carried out? What are they?

___

___

___

___

(68) Does anybody evaluate/assess the company trainers?
No Yes - Who? ___

(69) Please circle the number of people you think were killed in the NZ forest industry for 1992. (Guess if not sure)
1 3 5 7 9 11 13

(70) How many forestry accidents resulting in time off work do you think occurred in NZ for 1992?
(a) 50 to 99
(b) 100 to 149
(c) 150 to 199
(d) 200 to 249
(e) 250 to 300

(71) How many lost time accidents occurred in your company in 1992?___

(72) Do you have a self-inspection programme to identify hazards (including all health hazards) in the forest?
No Yes - Who does this? ___

(73) How are these hazards being reduced or eliminated?

____

(74) What safety programmes (not listed above) do you currently have in place? ____

(75) Are your workers aware of these?
No Yes

(76) What do you think is the underlying cause(s) of most accidents?

____

(77) How do you think safety could be improved and accidents reduced in the forest?

____

(78) How often do the following people talk to you about safety issues?

	Daily	Weekly	Monthly	Yearly	Never
(i) Other managers					
(ii) Your supervisors					
(iii) The bush inspector					
(iv) Your Trainers					

(79) How annoying do you think the following would be to forestry workers?

	Does not annoy me at all	Not too bad	Slightly annoying	Annoying	Very annoying
(i) Noise					
(ii) Heat					
(iii) Cold					
(iv) Weather (rain, wind)					
(v) Dust					
(vi) Mud					
(vii) Fumes (eg. smoke)					
(viii) Weeds (gorse, blackberry)					
(ix) Vibration					

(80) How much do you think the following items help reduce injuries?

	No help at all	Very little help	Does help a bit	Pretty helpful	Very helpful
(i) Helmets					
(ii) Visors					
(iii) Chaps					
(iv) Chainsaw trousers					
(v) Earmuffs					
(vi) Steel capped boots					
(vii) Spiked boots					
(viii) Cut resistant rubber boots					
(ix) High visibility gear					
(x) Chainsaw mitt					
(xi) Seatbelts					
(xii) Chainbrake					

(81) Safety is more important than profits, production and quality.

	Yes	No	Don't know
(i) Do you really believe this?			
(ii) Does your company really believe this?			
(iii) Do the workers believe that the company really believes this?			

(82) Overall, how would you rate the following in their attitude towards safety?

	Doesn't care	Bit slack	Alright	Good	Excellent
(i) Your company					
(ii) Your supervisors					
(iii) Your trainers					
(iv) Your workers					
(v) Your own					

APPENDIX E - CONSISTENCY RULES

A number of rules were programmed into SPSS Data Entry to test the consistency of responses. These rules were:

- Gearchek: q30 ge 4 and q31 ge 4 implies q33 le 3
- Check11: (experlog ge jobexper) or (expersil ge jobexper)
- Check37: q39 ge 4 implies q37 le 3
- Check46: (q46 ge 4 implies q 58 ge 3) and (q46 le 2 implies q58 le 3)
- Check48: (q48 = 5 implies q54 ge 3) and (q48 = 1 implies q54 le 3)
- Check53: (q53 = 5 implies q 63 le 3) and (q53 = 1 implies q63 ge 3)
- Checkcs1: (cs1 = 1 implies cs4 le 2) and (cs1 = 2 implies cs4 ge 2)
- Checkcs2: (cs2 = 2 implies cs5 ge 2) and (cs2 = 1 implies cs5 le 2)
- Policy: comsaf ge 0 implies foasafe ne 4
- Talksafe: talkbush ge 3 or talkbush = 0
- Accident: (accid5 = 1 implies accid1 = 1) and
  (accid1 = 2 implies accid5 = 2)

The rules are interpreted as follows: The first word is the name of the rule, eg. "Gearchek". The name of the rule is followed by a variable name(s) (eg. q30 and q31). The responses on this variable are compared to responses on another named variable (eg. q33). The rules allow relationships such as "greater than or equal to (ge)" to be specified. For example, the rule'Checkq46' states that if a subject agrees or strongly agrees (ge4) that "all injuries are preventable" (Q46), then they should not disagree or strongly disagree (ge3), with the statement that "all accidents are preventable" (Q58).

Rules, such as 'Accident' should never be broken. It states that if a subject has not had an accident in the last five years then they did not have an accident last year. This was programmed as an automatic skip and fill option so this case would only be broken if the data operator changed the auto fill value.

Due to the possibility of some rules being broken without the respondent being inconsistent, three or more rules had to be broken before the case was eliminated.

APPENDIX F - CREW AND COMPANY SUMMARIES

Attitudes Towards Safety - A Brief Summary (Crew)

General Information

A total of 465 people were surveyed for this project. This included 21 managers, 29 supervisors, 33 logging and 26 silviculture contractors, plus 195 logging and 161 silviculture workers. Most of the results presented in this summary are those from the contractor and worker groups surveyed.

One in every six workers said that they had a lost time injury last year. This is a very high figure. Fourteen percent of logging workers and nineteen percent of silviculture workers have been in the job for less than a year. The median (the middle value) work experience for logging is six years and for silviculture it is three years. This means for logging, half have been in logging for less than six years and half have been in the job for more than six years. The median length of time spent with the current crew was two years for logging and one and a half years for silviculture. These figures do not include missing data so the true median would be less.

In your crew:
The median work experience was 8 year(s).
The median crew experience was 1 year(s).

Half the workers surveyed said they had passed a FIRS module. This is an improvement over the last survey which was around 40 percent. There is still long way to go before the forest industry reaches its target of one hundred percent. In your crew 50 percent said they had passed a FIRS module.

The Work Environment

Virtually everyone rated forestry as very hard physical work where you need to keep your mind on the job. Seventy eight percent of contractors and workers also thought that their job can be very stressful at times.

There was a wide variety of responses to the question "How annoying would you rate the following? Noise, Heat, Cold, Weather, Dust, Mud, Fumes, Weeds, and Vibration (environmental stressors)". The weather and weeds were rated the most annoying, with noise and vibration being the least annoying. Overall, people found these environmental stressors slightly annoying.

Protective Equipment

Almost everybody rated protective equipment very highly with 83 % of those surveyed agreeing with the statement "I would wear the gear I wear now even if it was not compulsory." Spiked boots and high visibility clothing received slightly lower ratings than items such as helmets and chainsaw chaps. Many workers commented that they either had not seen these items or had never tried them so they did not know how good they were. Spiked boots and high visibility clothing need to be promoted in the areas in which they would be of use. LIRO research shows that spiked boots dramatically decrease the number of times fallers slip over in slash and on logs (Kirk and Parker, 1992). Wearing high visibility clothing increases the chance of loggers being seen by operators of machinery and other loggers (Bradford, Isler, Kirk & Parker, 1992).

Many workers commented that visors were a nuisance. Other workers noted that the chainsaw cuts through chainsaw trousers and boots. Due to these problems, chainsaw trousers are being redesigned and researchers are looking into ways to improve the boots and visors. Contractor input is essential for these efforts to be successful. If you have any ideas on how to improve protective equipment please contact LIRO.

Safety Policies

The Health and Safety in Employment Act 1992 came into effect on the 1st of April this year. It states the responsibilities of the employer and employees with regards to safety. It is important that everyone understands this Act. Thirty six percent of forestry workers surveyed had not heard of the Health and Safety in Employment (HSE) Act. Thirty one percent of workers and nineteen percent of contractors had heard of the HSE Act but were unsure about its meaning. Thirty three percent of workers and eighty one percent of contractors thought they fully understood the new Act.

In your crew:

11 percent of workers had not heard of the HSE Act

33 percent of workers had heard of the Act but were unsure about its meaning.

56 percent of workers thought they fully understood the HSE Act

Forty three percent of contractors said they do not have a gang safety policy. The law now requires you to have a safety policy which your workers understand.

In your crew:

11 percent of workers said they had not seen a gang safety policy.

0 percent of workers had seen the gang safety policy but were unsure about it.

89 percent of workers said that they understood it.

Thirty three percent of contractors were also unsure about the company safety policy. Everybody working in the forest needs to be aware of the company safety policy and operating procedures.

In your crew:

22 percent of workers said they had not seen a company safety policy.

22 percent of workers had seen the company policy but were unsure about it.

56 percent of workers said that they understood it.

If you are uncertain about the HSE Act, what you are required to do, or the company safety policy; then contact OSH or ask your supervisor. Make sure all your workers have read these policies and fully understand them. The HSE Act requires you to do this.

Risk

Eighty eight percent of workers and contractors agreed that forestry is very dangerous work. Thirty percent thought that taking risks is part of the job. People should not have to take risks to do the job. This should be emphasised to all workers. If they are in doubt about the safety of doing a particular job then they should leave it and inform the contractor. This also applies to the contractor if s/he is unsure about the safety of the operation. Always inform your supervisor about your concerns.

Most people do not have a very good knowledge about how many people were killed or injured last year. The number of people killed in logging during the 1992 calender year was nine. The number of people killed during the 92/93 financial year was eleven. You should get copies of the OSH bush bulletin either from OSH or your supervisor.

LIRO also produces quarterly accident statistics which show the number of injuries, the type of operation, the job being done, and the severity of the injury. These should be circulated around workers so they are kept aware of the dangers in their job. Contact LIRO if you would like to receive these accident summaries.

People - Commitment to Safety

Figure one below shows the number of people that agreed with the following questions.

Safety is more important than profits, production or quality.

(Q1) Does your boss really believe this?

(Q2) Does your supervisor really believe this?

(Q3) Do your workmates really believe this?

Figure one shows us that around 50 percent of workers think their boss and supervisor are committed to safety. Over 70 percent of contractors said they did believe safety was most important.

FIGURE 1

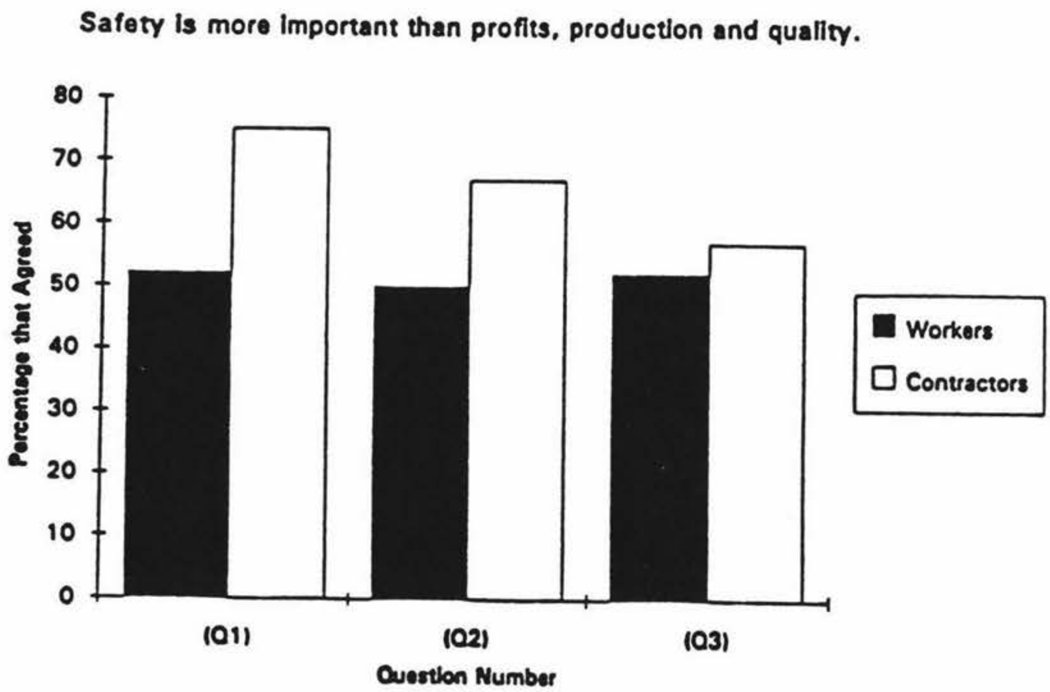


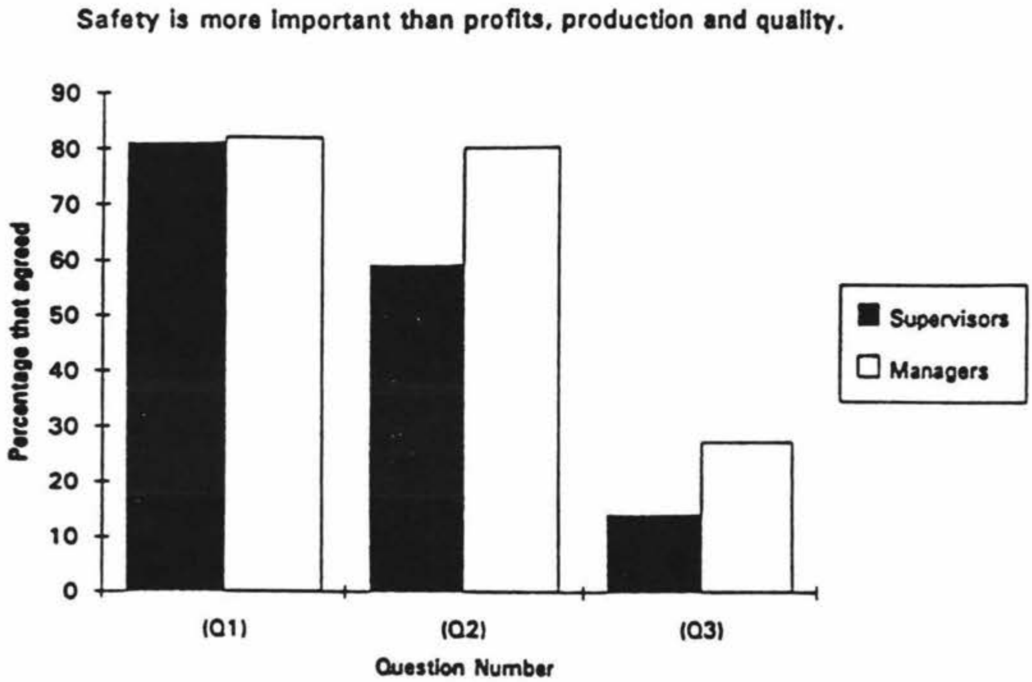
Figure two below shows managers and supervisor responses to the following questions.

(Q1) Do you really believe this?

(Q2) Does your company really believe this?

(Q3) Do think workers believe that the company believes this?

FIGURE 2



Most supervisors and managers said that they did believe that safety was most important. Less than 60 percent of supervisors thought that the company really was committed to safety. Very few supervisors and managers thought that workers would believe that the company was committed to safety. Companies and contractors need to change this attitude. It is important that safety is the first priority. You should not be doing the job if you do not think you can do it safely. It is very important that you get this message across to your workers. If you let them know your committed to safety then they will act safely. Make your commitment to safety visible with regular training on safety, safety meetings, hazard inspections and general reminders about safety.

General Views

Virtually all workers believe they have control over their own safety. They do believe that safety is important and everybody is responsible for safety. Most workers agree that even experienced workers need to be reminded about safety. Below is a table of results for some of the general questions. It presents the industry averages for how many people agreed and disagreed with the questions. Your crew averages are then presented. Notice that the total percentage does not equal 100 percent. This is because the "uncertain" column is not included.

TABLE OF CREW RESULTS				
	Industry average %		Your Crew %	
	Disagree	Agree	Disagree	Agree
I enjoy taking chances.	76	15	78	11
All injuries are preventable.	31	53	11	89
I'm too busy to worry about safety.	85	10	100	0
Accidents happen because workers are too careless.	31	54	22	78

Generally you do not want workers that enjoy taking chances in the job. Nobody wants unnecessary risks. It is important to believe "all injuries are preventable" so that no accidents are treated as acceptable or as part of the job. We must attempt to prevent all injuries. People should never be "too busy to worry about safety" as it should be their first priority when doing a job.

Many people paused when answering the question "Accidents happen because workers are too careless". Half the people surveyed agreed with this statement and made comments that workers need to pay more attention to what they are doing. Although the majority of accidents are due to people making errors, these errors are generally not due to a lack of attention or carelessness. Forestry work requires people to pay attention for long periods of time. The problem is that it is not mentally possible to notice everything around you all the time.

We all make errors in our jobs. Workers will be missing hazards all the time. Theory states that generally there are 100 000 unsafe acts before a serious accident occurs. Instead of just saying someone is careless we need to try to find some way of removing these hazards. Don't rely on the workers to notice all of the hazards. Mechanised systems and safer work practices are some ways of reducing the hazards a worker is exposed to. Safety training will help workers handle the hazards safely and safety meetings increase the awareness of the hazards, but unless we reduce the number of hazards, accidents will continue to occur.

Suggestions to Improve Safety

The comments made by everyone surveyed can be broken down into the following categories. Some of these categories have been mentioned above.

(1) Reduce Pressure - Lower Targets - Slow Down.

(2) Increase pay so you don't have to push yourself to earn a living.

(3) Training and Education.
- Compulsory Induction Training.
- Meeting LFITB Standards.

(4) Pay more attention. Not being careless.

(5) More safety meetings and courses.

(6) Safer work techniques.

(7) Mechanised Systems.

(8) Change in attitude required.

(9) Greater Commitment - More professional approach.

(10) Identify the hazards.

Many workers still believe that they are under pressure. They may fear losing their job unless they perform, think that the contractor or company wants them to reach a target or feel they need to work fast to earn a decent living. It is important that workers do not feel that they are pressured into doing unsafe acts. This will be hard to achieve unless there is a general concern for workers and job security. Workers, contractors, supervisors and managers mentioned the need for more training, not only for forestry workers but also for contractors and company personnel. Supervisors and managers also said greater commitment and a more professional approach to the safety problem was required.

A change in attitude is required. On the whole, those surveyed did not have a bad attitude towards safety. But due to the fact that forestry is one of the most hazardous jobs in this country everybody needs to be fully committed to safety. The forest industry needs to be doing more than any other industry if it wishes to bring down the accident rate. Safety decisions need to be made at the same level as decisions on production, profits and quality. Companies and contractors need to look at all aspects they may effect safety, especially the human factors. Your workers are your greatest asset. If they are well trained, experienced and can work together as a team, your chances of having an accident decreases. Length of working day, number of days spent working, number of smoko breaks, job interest and the general work environment needs to be considered to help workers remain alert and interested in their job. If fatigue and boredom set in then so do the opportunities for errors, accidents and loosing money.

All accidents need to be taken seriously including sprains and strains plus long term ill effects like back injuries and melanoma. It is these problems that are the most costly in the long term. Sprains and strains make up 80 percent of ACC costs and 90 percent of claims. Increased awareness of the long term ill effects of forestry work is needed. Do not just target your serious accidents. Look at all the problems because they are related. Previous research as found correlations between suffering back pain and accident involvement. Improving one area may help improve another.

Many people will not buy the best gear available for protection because it costs to much. This can put the manufacturers off improving the equipment. Yet the extra money invested in a decent pair of spiked boots or chainsaw chaps will save you money and reduce suffering in the long run. The cost is still minor compared to the general costs of running a operation. Plus the investment can reduce injuries, lost time and production, ACC levies, visits to the doctor and investigations. Good equipment also lasts longer, helps you get rebates when you don't have an accident and improves the morale of the crew due to a visible interest being displayed for their well-being. Show people that safety is number one in your crew. All these efforts will help production.

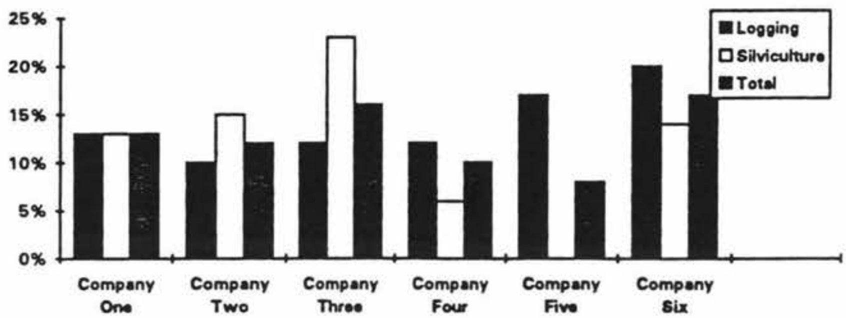
Remember - Safety is good business.

Attitudes Towards Safety - A Brief Summary (Company)

Demographic Information

A total of 465 people from six companies were surveyed for this project. This included 21 managers, 29 supervisors, 33 logging and 26 silviculture contractors, plus 195 logging and 161 silviculture workers. One in every six workers said that they had a lost time injury last year. Figure one below shows the percentage of logging and silviculture workers who had a lost time accident last year (an accident which caused one or more days off work). There is insufficient data to draw any conclusions regarding company five.

Figure 1. Lost time accidents in 1992



These figures are higher than those recorded by the Logging Industry Accident Reporting Scheme or the companies. This result suggests a problem with under reporting. With the new ACC levy system this problem may grow unless some steps are taken to encourage the reporting of accidents. The number of accidents is still unacceptably high for all companies. Although there are differences between the companies, these are not statistically significant with this sample size. During the survey, many companies were in the process of implementing new safety policies to meet the requirements of the Health and Safety in Employment Act (1992) and improve safety. The following information identifies problems that will need to be addressed if accidents are to be dramatically reduced.

Work Experience

Smith, Cohen, Cohen, and Cleveland (1978) and Simonds and Shafai-Sahrai (1977) matched pairs of low and high accident rate companies. They found that one of the characteristics of companies with low accident rates was low turnover and absenteeism rate. Figures 2 and 3 indicate turnover and work force stability.

Figure 2. Median number of years work experience

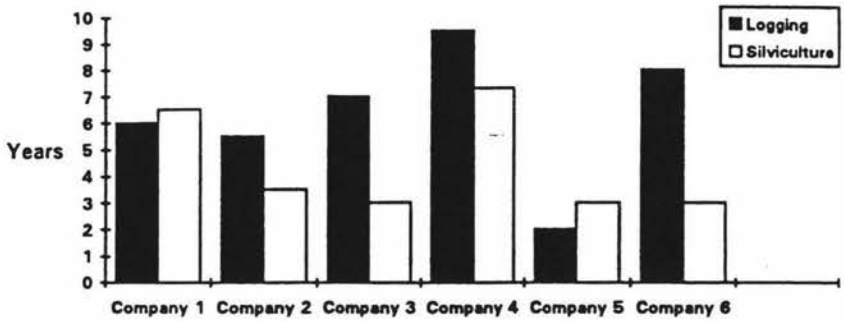
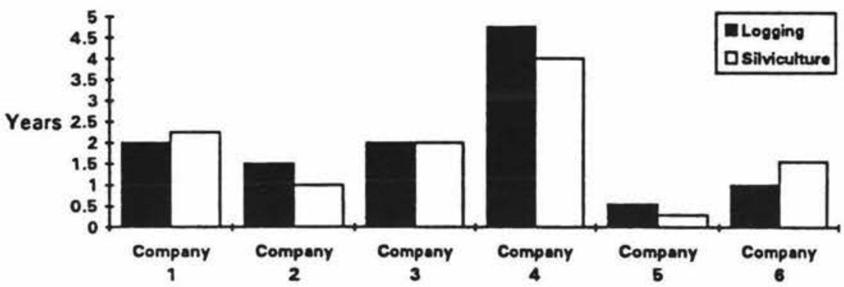


Figure 3. Median length of time spent with current crew



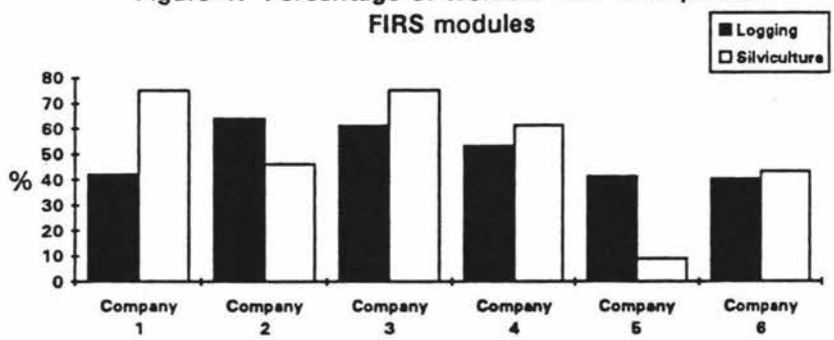
The median work experience is six years for logging and three years for silviculture. This means for logging, half the workers have been in logging for less than six years and half have been in the job for more than six years. The median length of time spent with the current crew was two years for logging and one and a half years for silviculture.

The graphs indicate that there is a high turnover in forestry which will make it difficult to achieve a low accident rate. These graphs also under estimate turnover due to the number of missing responses. Company four has the most stable work force and lowest accident rate (10%). The highest accident rate (17%) was found in company six which also has a high turnover within their crews.

Training

Training enables work to be conducted in a safe, efficient and productive manner. The Logging and Forest Industry Training Board recognises trained workers through the Forest Industry Record of Skills (FIRS) Modules. Figure 4 shows the number of workers that said they had passed some FIRS modules.

Figure 4. Percentage of workers who have passed FIRS modules



Fifty percent of workers have passed FIRS modules. Workers, contractors, supervisors and managers all mentioned the need for more training, not only for the workers, but also for contractors and company personnel.

The Work Environment

Virtually everyone rated forestry as very hard physical work where you need to keep your mind on the job. Seventy-eight percent of contractors and workers also said that their job can be very stressful at times. There were a wide variety of responses to the question "How annoying would you rate the following? Noise, Heat, Cold, Weather, Dust, Mud, Fumes, Weeds, and Vibration" (environmental stresses). The mud and weather were rated the most annoying by loggers. Silviculture workers found the weather and weeds most annoying. Overall, everyone thought that the noise and vibration were the least annoying with the other environmental stresses being slightly annoying.

With a high physical and mental workload, plus annoying environmental conditions, it is very difficult to maintain attention and not get fatigued. Melamed, Luz, Najenson, Jucha, and Green (1989) found that accident involvement increased when the work was demanding and people found the environmental conditions annoying. Due to these findings, close attention should be paid to factors that can effect safety and performance. Length of working day, number of days spent working, number of smoko breaks, job interest and the general work environment needs to be considered to help workers remain alert and interested in their job. If fatigue and boredom set in then so do the opportunities for errors, accidents and lost production.

Protective Equipment

Almost everybody rated protective equipment very highly with 83% of those surveyed agreeing with the statement "I would wear the gear I wear now even if it was not compulsory". Spiked boots and high visibility clothing received slightly lower ratings than items such as helmets and chainsaw chaps/trousers. Many workers commented that they either had not seen these items, or had never tried them, so they did not know how good they were. Spiked boots and high visibility clothing need to be promoted in the areas in which they would be of use. LIRO research shows that spiked boots dramatically decrease the number of times fallers slip over in slash and on logs (Kirk & Parker, 1992). Wearing high visibility clothing increases the chance of loggers being seen by operators of machinery and other loggers (Bradford, Isler, Kirk & Parker, 1992).

Safety Policies

The Health and Safety in Employment (HSE) Act 1992 came into effect on the 1st of April 1993. It states the responsibilities of the employer and employees with regards to safety. It is important that everyone understands this Act. Thirty-six percent of forestry workers surveyed had not heard of the HSE Act. Thirty-one percent of workers and 19% of contractors had heard of the HSE Act but were unsure about its meaning. Thirty-three percent of workers and 81% of contractors thought they fully understood the new Act.

Figure 5. Contractors - Do you understand the HSE Act

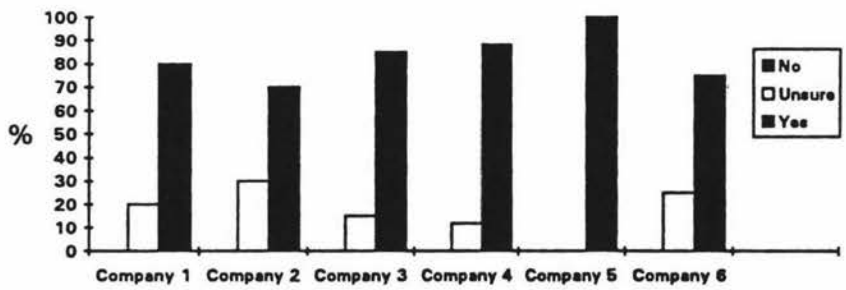
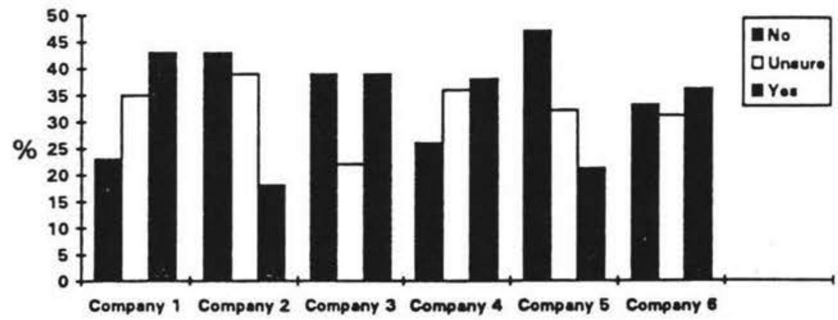


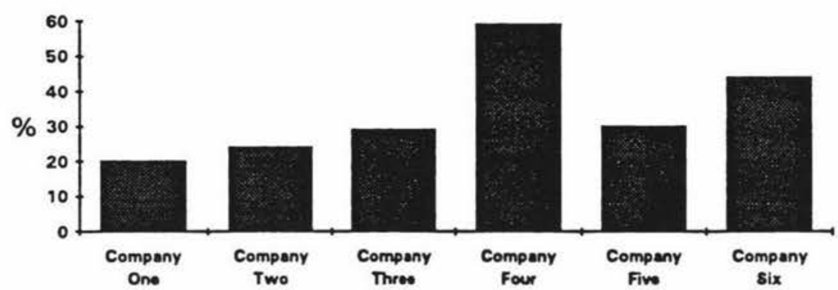
Figure 6. Workers - Have you heard of the HSE Act



Despite the majority of contractors saying they understood the HSE Act, only 57% had a gang safety policy. Some of these contractors were referring to the company policy rather than their own separate policy.

Figure 7 shows that few people understand or have seen the company safety policy. Others had just seen the company emergency procedures form. Everybody working in the forest needs to be aware of the company safety policy and operating procedures. A real effort needs to be made to educate workers about this.

Figure 7. Percentage of Workers and Contractors who understood the Company Safety Policy



Risk

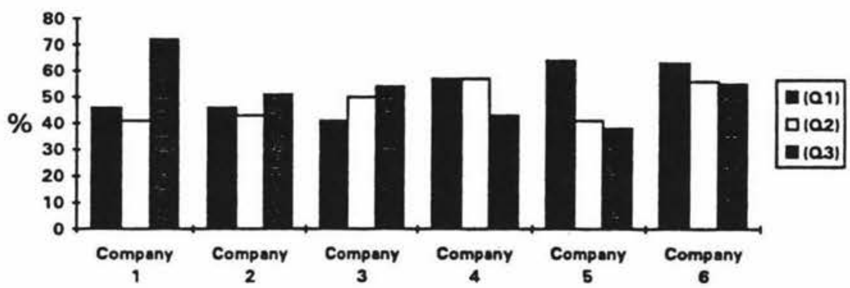
Eighty-eight percent of workers/contractors and 71% of managers/supervisors agreed that forestry is very dangerous work. Thirty percent of contractors/workers and 10% managers/supervisors thought that taking risks is part of the job. Taking risks should not be viewed as part of the job, as people should not have to take risks to do the job. This should be emphasised to all workers. If they are in doubt about the safety of doing a particular job then they should leave it and inform the contractor or supervisor.

Most people do not have a very good knowledge of the number of people killed or injured in the industry last year. The number of people killed during the 1992 calender year was nine. The number of people killed during the 92/93 financial year was eleven. Most managers and supervisors were unaware of their own companies injury/accident rate, yet all companies stated they have safety goals or targets. Goal setting is one of the most powerful ways of improving or achieving anything but it will only work if there is regular feedback and reinforcement to everybody. Goals are meaningless without this. Everybody needs to be aware of goals, agree that they are achievable, and then want to achieve them. Then there needs to be regular feedback on your performance towards the goal. If you have a production target, do you just set it, then a year later see if you reached it? I would suggest that you constantly monitor your performance. Why treat safety any differently?

Commitment to Safety

Figure 8 shows the number of workers that agreed with the following questions.
Safety is more important than profits, production or quality.
(Q1) Does your boss really believe this?
(Q2) Does your supervisor really believe this?
(Q3) Do your workmates really believe this?

Figure 8. Workers - Safety is more important than profits, production or quality.



On average, half the workers thought their boss and supervisor were committed to safety. In any one crew, half the workers may have said their boss or supervisor was safety conscious and the other half of the crew may say that the boss or supervisor is terrible when it comes to safety. These are personal impressions and it is these impressions that count. Everybody must be committed to safety and show it if accidents are to be reduced. Only half the workers thought that their workmates were committed to safety. These are very low figures that must be improved. Figure 9 below displays the number of contractors who agreed with the same questions.

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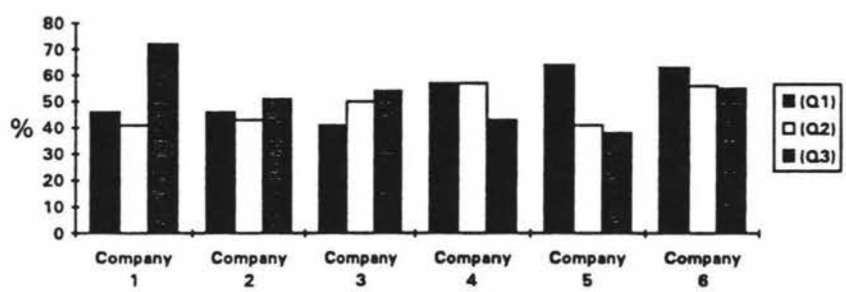

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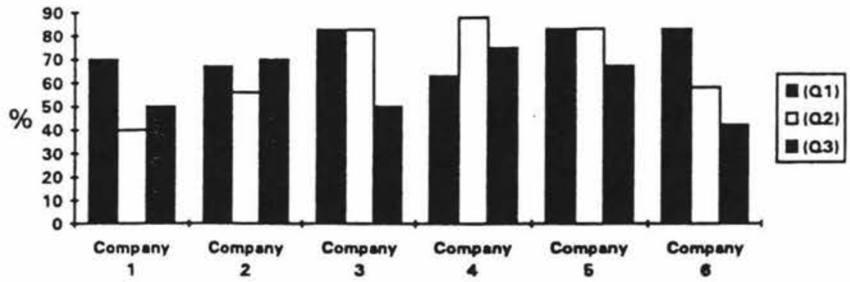
Figure 9. Contractors - Safety is more important than profits, production or quality.



Overall, contractors were more positive about safety than the workers with 75% saying they believed safety was most important. Sixty-seven percent of contractors thought that their supervisor was committed to safety and just over half the contractors thought that their workers were committed to safety. Managers and supervisors were asked similar questions which are presented below. The percentage of respondents who agreed with the questions are displayed in figures 10 and 11.

Safety is more important than profits, production and quality.

(Q1) Do you really believe this?

(Q2) Does your company really believe this?

(Q3) Do the workers believe that the company believes this?

Figure 10. Supervisors - Safety is more important than profits, production and quality.

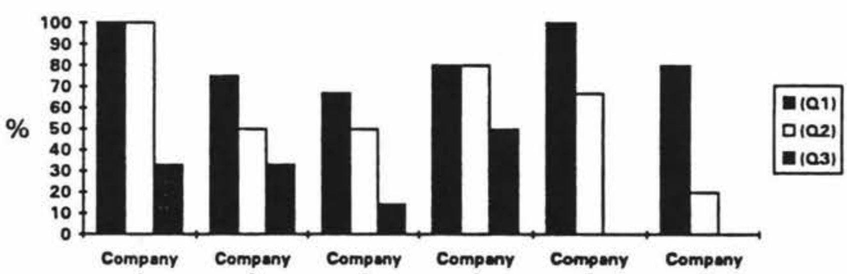
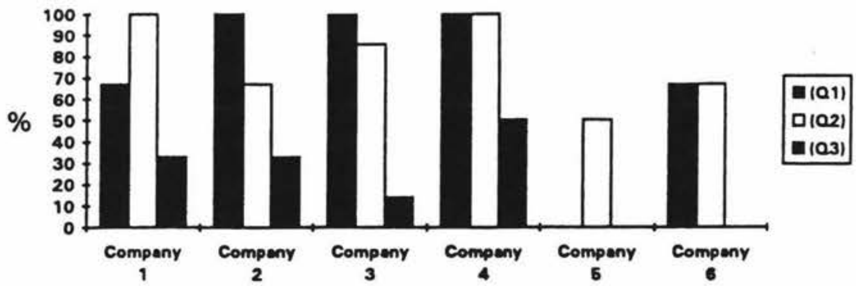


Figure 11. Managers - Safety is more important than profits, production and quality.



Their are some interesting differences between managers and supervisors as well as companies. Most people said they believed safety was most important but many doubted whether their company did. Question three produced the most interesting result. When asked whether the workers would believe the company was committed to safety the percentage fell down to 16%. Nobody in company five or six thought that the workers would believe the company is committed to safety. These figures are perhaps the most important. Unless everybody believes that the company is committed to safety, efforts to improve safety will not be very effective. Many managers and supervisors mentioned that greater commitment, a more professional approach to the problem and a change in attitude was required.

This is where the big problem lies. Attitudes do need to change and a professional commitment made. Forestry is one of the most hazardous jobs in New Zealand, so everybody needs to be fully committed to safety. For example, if a worker makes an error that results in an injury, most companies attribute the accident to the worker. They then tell the worker to be more careful. Fully committed companies will examine how the worker came to make the error. Did the company train and educate the worker well enough? Was the job too hazardous? How can this be changed? Fully committed companies view accidents as a weakness of their operation, not the worker's ability. Research suggests that this is the most successful way of reducing accidents.

This commitment must come from senior management (Griffiths, 1985). With advice from Du Pont (world leaders in safety), the number of lost days dropped from over 4000 to 21 in a industrial gases company (in ten years). Griffiths attributes this result to top management creating the climate for improving safety, by demonstrating its commitment, and making everybody except responsibility.

Hansen (1993) cited recent surveys that found the majority of companies are still in the traditional mode of dealing with safety. Most of the efforts to improve safety are reactive. There are safety programs, safety slogans, policies and safety committees. However, nobody accepts true responsibility for accidents, the safety policies are weak, programs are short-lived, accidents are tolerated, and there is no real safety strategy.

In forestry, it appears that all the production and quality strategies are developed, then, as a final note, people are told to "do it safely". A quote from Minter (1993, cited in Krause, 1993) helps explain why this method will not work. "If the basic nature of how a company operates is directly responsible for the production of injuries and illnesses, it stands to reason that reactive, add-on safety programs stand little chance of success".

Forest companies must accept that the way they are currently operating is causing injuries, illnesses and death. To change this, companies must be pro-active. Pro-active safety systems are much more effective than reactive (Chappell, 1992). To be pro-active you must accept that poor safety is a reflection of poor management. The majority of recent research on safety emphasises managements role in improving safety (Skiff, 1993). You do not "add on safety", you include it in every management decision. Management must create the climate for improving safety. Dedobbeleer and Beland (1991) found management commitment to safety and workers involvement in safety were the two factors which best described the safety climate.

Pro-active commitment requires a humanistic, total quality approach to management. Smith (1993) and Watkins (1993) stressed the importance of a Total Quality Management Approach to safety. The literature is full of examples of companies that have achieved safety through commitment from the top and worker involvement. For example, Painter and Smith (1986) managed to reduce a logging companies accident frequency by 75% and compensation costs by 62%.

Stoley (1993) cited an example of a successful safety system from British Coal Nottinghamshire. The first step was changing attitudes at management level. Safety was made first priority at every meeting, personal statements of commitment were made and communication was increased. Targets were set and communicated to the whole work force. Areas that needed greatest attention were communication, standards, motivation, training, and accident investigation. The second stage involved intensive training. This training concentrated on skills such as safety audits whereby people are observed then involved in team discussions with the aim of improving safe practices. For the first time in history, their aim of "safety management through people" led to a fatality rate of zero.

General Views

Most workers believe they have control over their own safety, that everybody is responsible for safety and even experienced workers need to be reminded about safety. Figures 12 and 13 present the percentage of people that agreed with two important questions.

Figure 12. All injuries are preventable

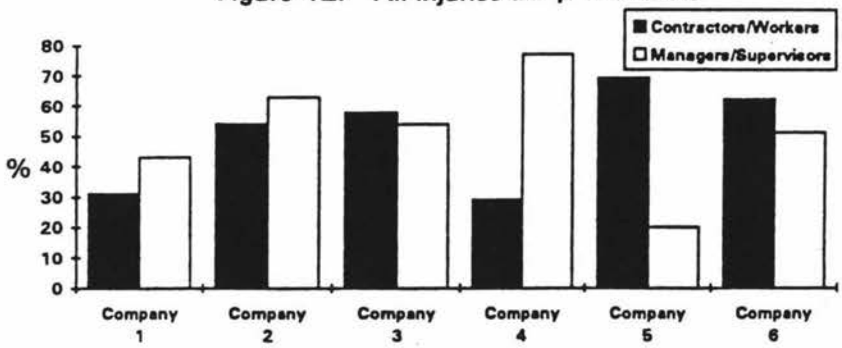
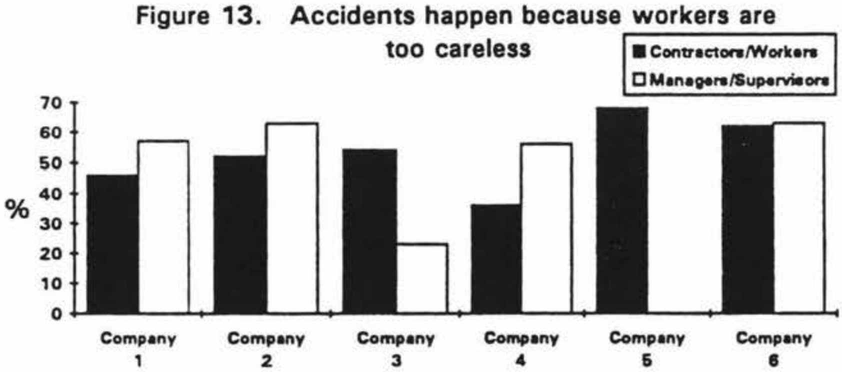


Figure 13. Accidents happen because workers are too careless



It is important to believe "all injuries are preventable". Unless you believe this, accidents become acceptable or are viewed as part of the job. Many people hesitated when answering this question. They do know you should believe this but in forestry they do not think it is possible.

Many people also paused when answering the question, "Accidents happen because workers are too careless". Half the people surveyed agreed with this statement and made comments that workers need to pay more attention to what they are doing. The forestry industry must move away from placing blame on workers when looking at accidents. The common advice "Pay more attention" or "Be more careful" will never reduce your accident rate. It is not possible for people to notice everything about them and not make any errors. People that attribute accidents to lack of attention or carelessness are probably making the "fundamental attribution error". This term is used to describe the tendency of observers to attribute other people's behaviour to internal factors such as their personality. However, when you are placed in a similar situation, you describe your own behaviour in terms of the situation you were in. This error results in inappropriate solutions that will not prevent accidents in the future (Dejoy, 1985).

Do not rely on the workers to notice all the hazards. Safety training will help workers handle the hazards safely and safety meetings will increase the awareness of the hazards, but unless we reduce the number of hazards, accidents will continue to occur. Mechanised systems and safer work practices are some ways of reducing the hazards a worker is exposed to.

Accidents are due to errors in the system. Something must change after an accident to prevent it happening in the future. It appears that many solutions only involve the crew where the accident happened, yet the errors are in the work practices and organisation which effects all crews.

The key to accident investigations is collecting information, not data. Many accident forms are completed with lots of ticked boxes and a description of what happened. Generally the data is not put into a computerised accident reporting system. Is the data being used or is it just recorded? For data to become information it must be converted to a form which managers can read and make informed decisions (Bradford and Cohen, 1992). This should include the cost of the accident, cost of solutions and expected benefits from the solution.

People generally underestimate a cost of an accident. If a person has an accident that results in two weeks off work the costs would include: damage from the accident, cost of all personnel in accident investigations, medical costs, loss of wages, ACC levies, loss of ACC rebate, potential fines, the loss the injury causes the person, and the crew being less productive for that period even if a replacement is found. To put a dollar value on the benefits of safety systems is extremely difficult as many of the benefits are intangible and the majority of benefits will not be seen immediately. There are equations that help do this such as the expected value technique (Friend, 1992).

All accidents need to be taken seriously including sprains and strains plus long term ill effects like back injuries and melanoma. It is these problems that are the most costly in the long term. Sprains and strains make up 80% of ACC costs and 90% of claims. Increased awareness of the long term ill effects of forestry work is needed. Previous research has found correlations between suffering back pain and accident involvement (Sherry, 1991). Address the problems of high turnover, low training, perceived lack of commitment and safety because they are related. Show people that safety is number one in your company. All these efforts will help production. Watkins (1993) stated "The safer the work force, the more productive the work force". Do not look upon safety as a burden, it is a challenge!! It is a part of your business that has the potential for great improvement.

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APPENDIX G - COMPANY DIFFERENCES IN ATTITUDES

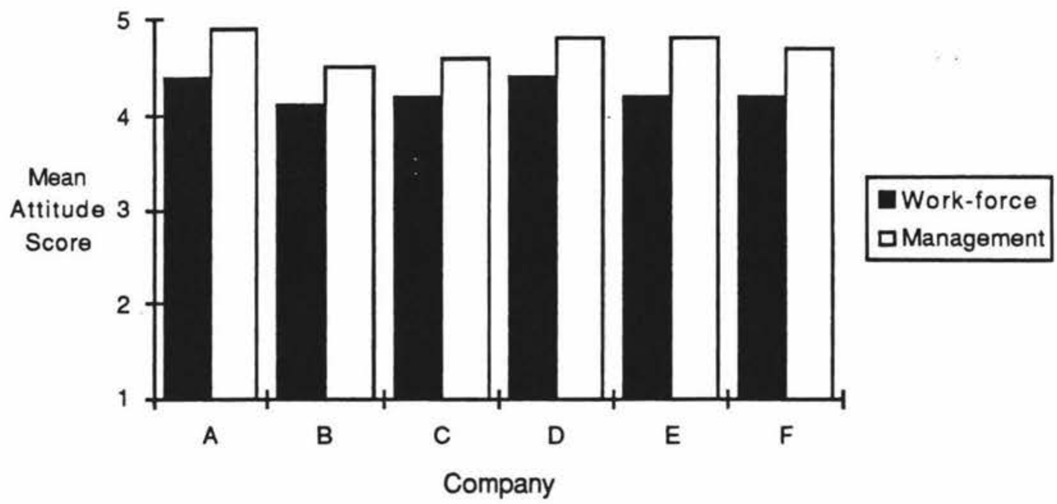

Figure A. Mean attitudes towards personal protective equipment scale scores by company

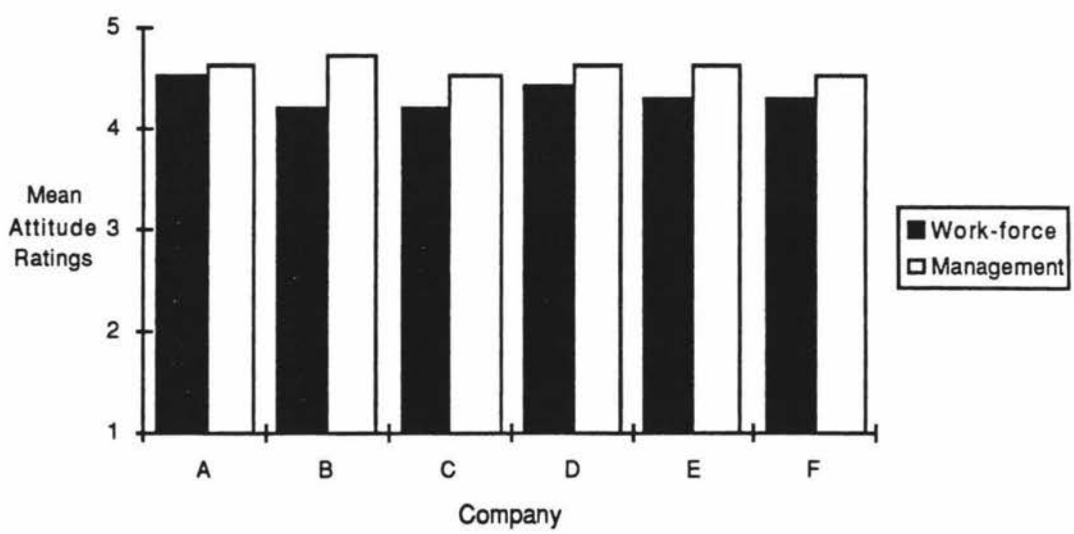

Figure B. Mean ratings of personal protective equipment scale scores by company

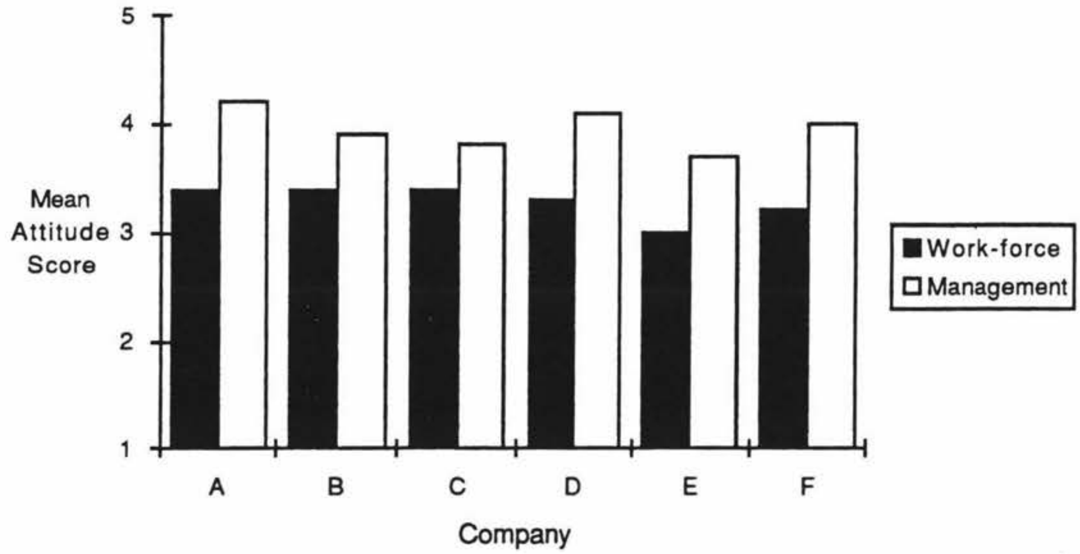

Figure C. Mean work environment scale scores by company

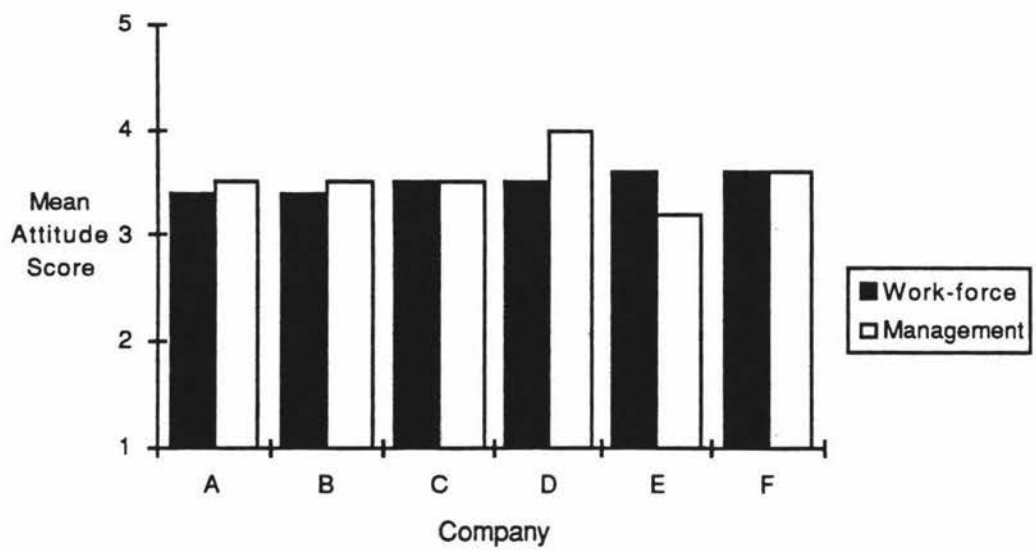

Figure D. Mean safety arrangements scale scores by company

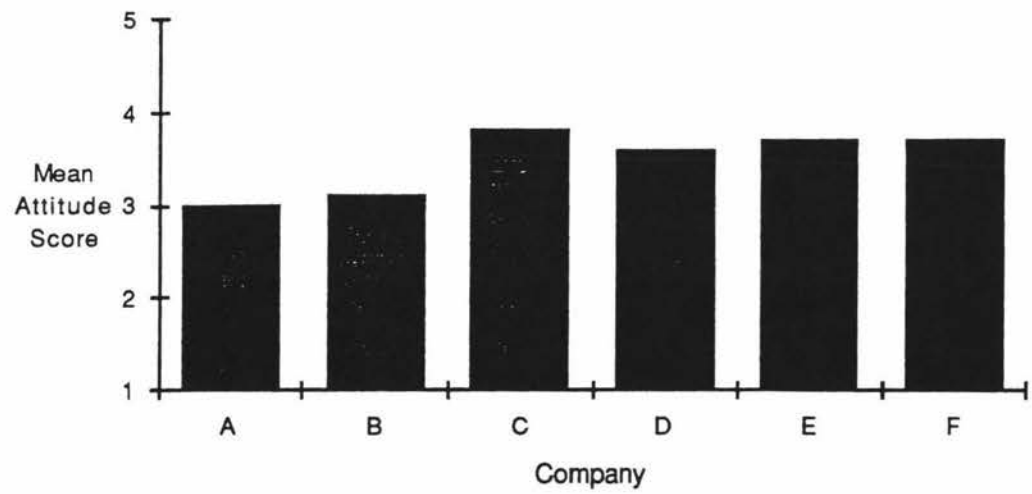

Figure E. Mean safety awareness scale scores by company (work-force only)

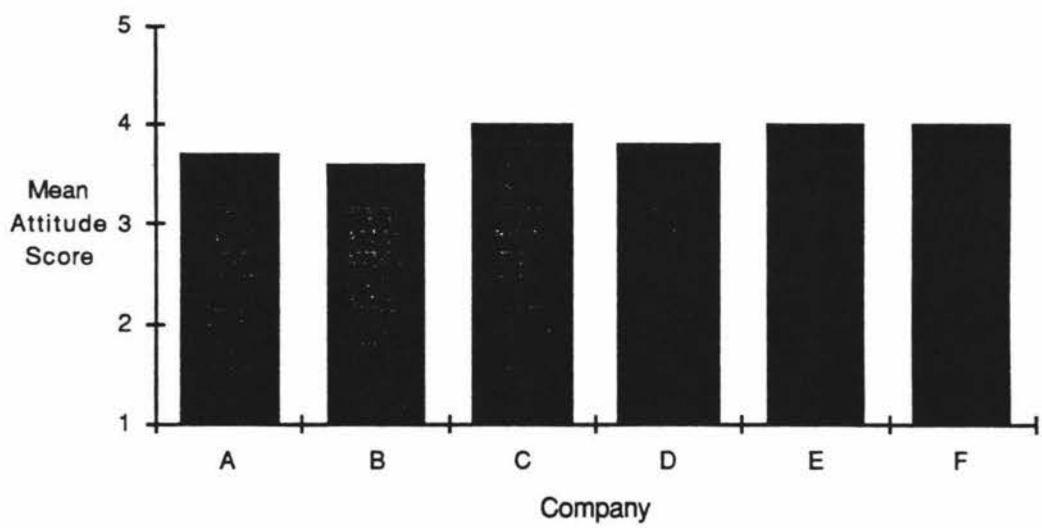

Figure F. Mean contractors handling of safety scale scores by company (work-force only)

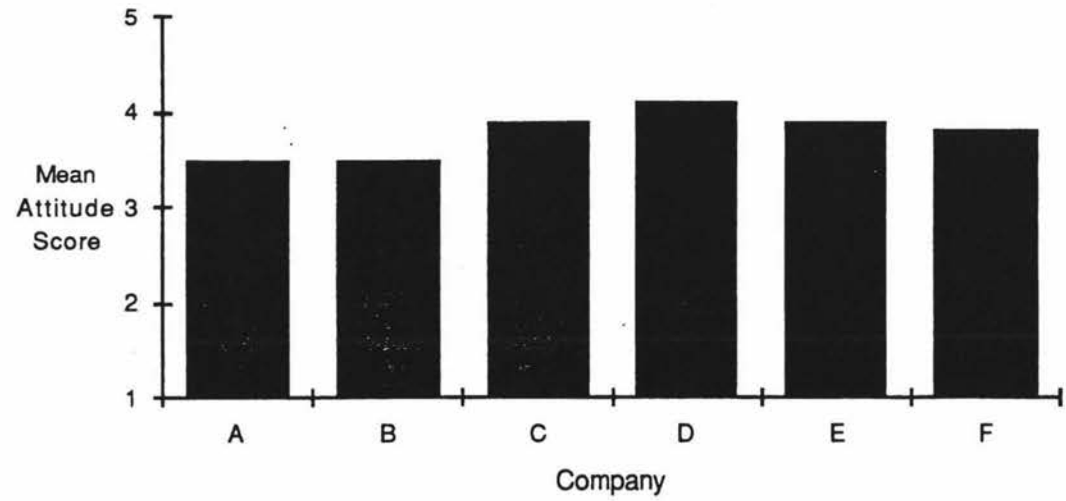

Figure G. Mean supervisor handling of safety scale scores by company (work-force only)

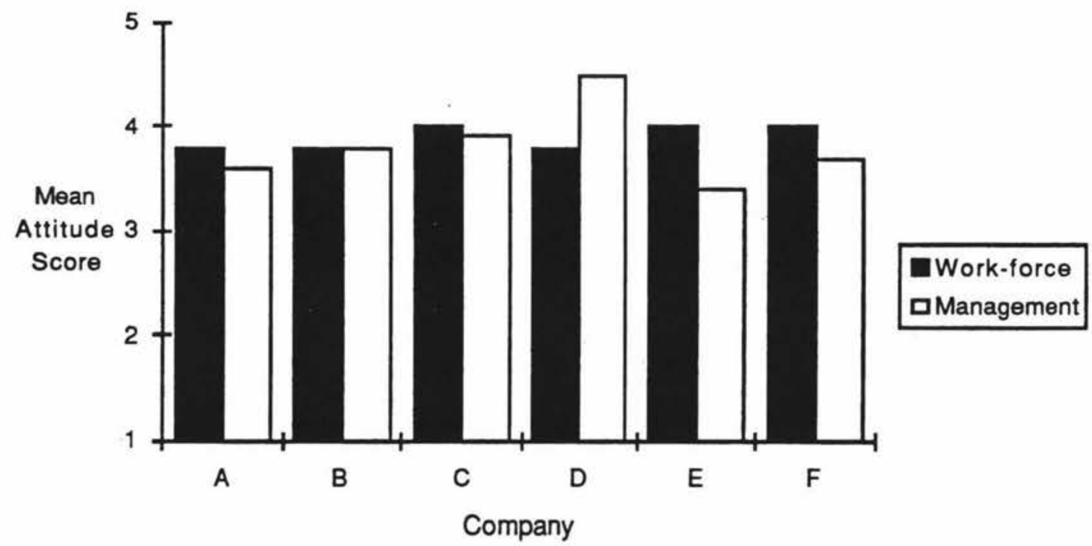

Figure H. Mean scepticism scale scores by company

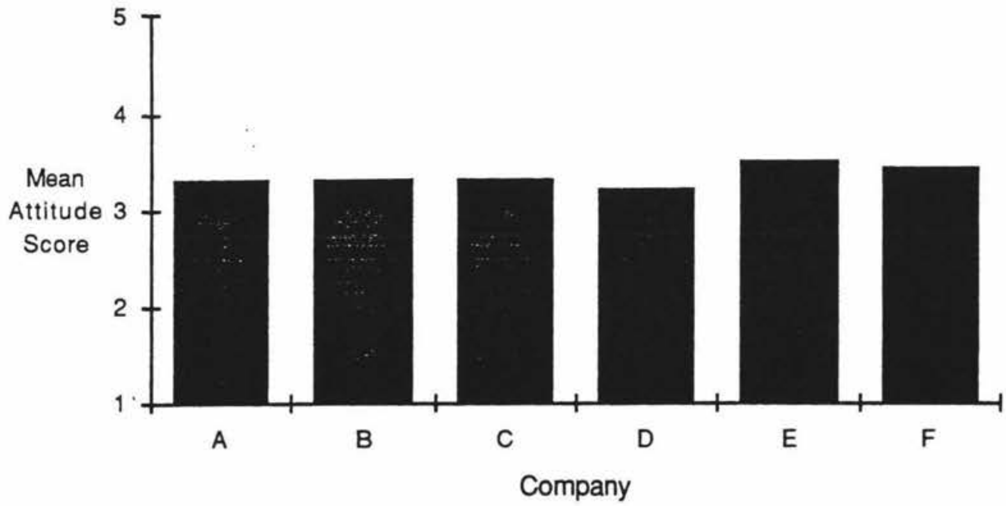

Figure I. Mean locus of control scale scores by company (work-force only)

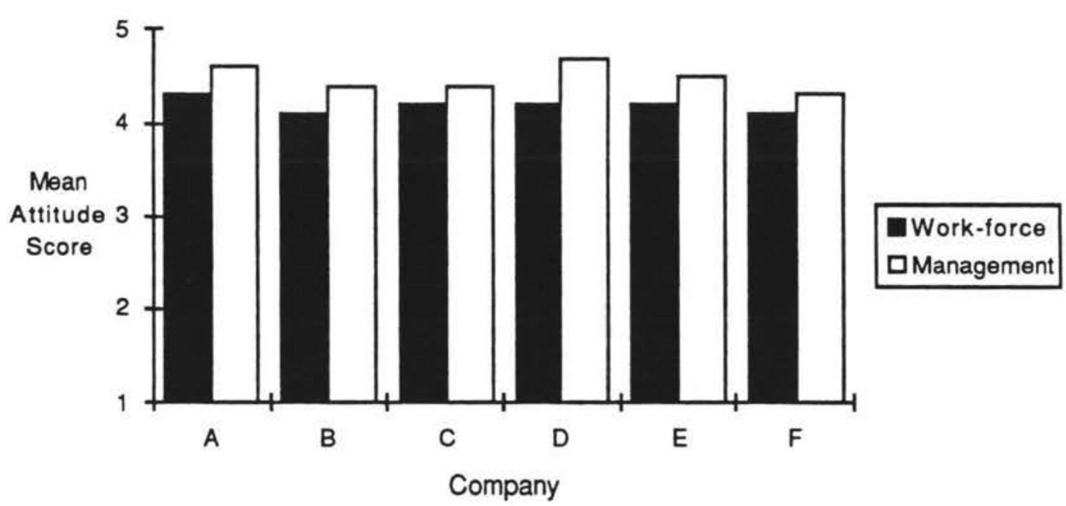

Figure J. Mean responsibility scale scores by company

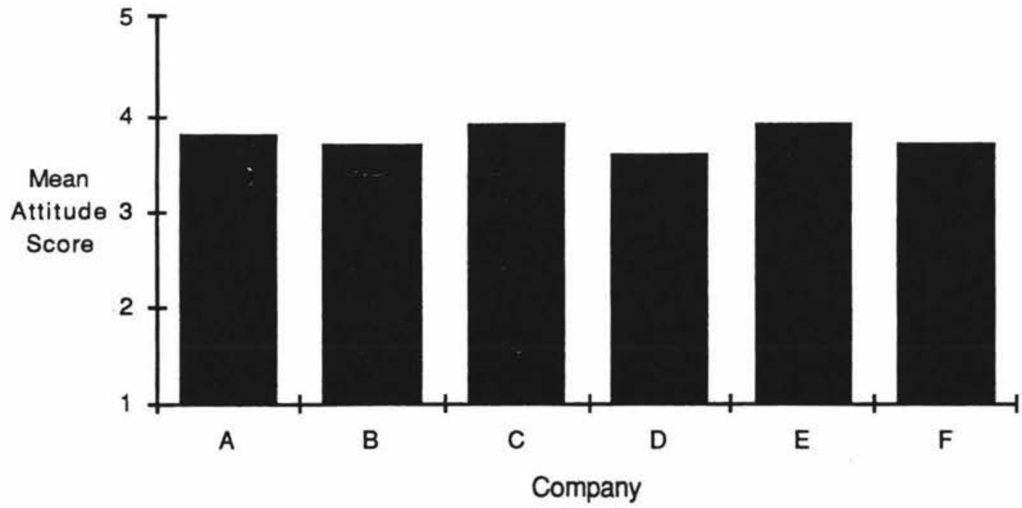

Figure K. Mean risk taking scale scores by company (work-force only)