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A pilot study of an employee developed observational tool as a valid and reliable measure of organisational safety

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by

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USE OF THESIS

ABSTRACT

Given the increasing high social and economic costs of occupational injury and illness to the Australian community, identification of initiatives to reduce the burden is urgently required. Paramount to reversing this trend is the need to identify and address the causes of the injury and illness. Employee involvement in occupational health and safety has for some time been espoused as an essential element in any occupational health and safety program, but its relationship with safety performance still remains unexplored. Although various theories suggest that the involvement of employees will increase their sense of ownership, there is little research to suggest that employees have the ability to develop a valid and reliable tool to measure safe practices in the workplace. The primary purpose of this study was to provide preliminary evidence of content and construct validity of an employee developed checklist in measuring compliance with safe behaviours. The second objective was to compare behaviours at two workplaces, one with an incentive scheme to promote safe behaviour and one without. The third objective was to determine the relationships between demographic characteristics of participants and compliance with safe behaviour. The study was conducted in two distinct phases. The first phase was an instrument development phase while the second was an implementation phase. Phase I involved the design of an employee developed checklist (EDC) and a theoretically developed checklist (TDC). Content validity testing was conducted by a panel of five experts in the field of instrument design and occupational health and safety. Phase II involved the observation of a sample of 44 ride on lift truck operators from two large manufacturing and logistics companies based in Victoria, over a three month period to measure compliance with safe work practices. Data was analysed to establish whether the EDC is a valid and reliable tool when compared against the TDC.

The results provide preliminary evidence to suggest that employees possess the necessary skill and knowledge to develop a valid observational checklist. A Wilcoxon signed-ranks test for dependent samples indicates that there was no significant difference between the compliance scores recorded on the EDC and the scores recorded on the TDC. Further analysis of scores obtained for three items on the EDC were analysed against similar items on the TDC with no significant difference found. Additionally, analysis of the correlation between the scores obtained on the TDC and EDC revealed a moderately strong positive relationship between the two checklists ($r_s = 0.414$, $p=.032$). Inter rater reliability testing by intra class correlation and percentage agreement revealed problems with both the EDC and TDC, which may be partially explained by the relatively high level of compliance with safe behaviour at both sites and the method of testing. In this sample, age, gender and the presence of safety incentive schemes had no significant effect on the level of compliance. The level of experience did, however, show a positive relationship with compliance levels ($r_s = 0.32$, $p=.048$). The results of this study present a number of potential benefits for workplaces including the justification of employee involvement in occupational health and safety measurement, employee involvement in goal setting and the feasibility of developing a proactive, inexpensive and flexible measure of occupational health and safety performance.

I certify that this thesis does not, to the best of my knowledge and belief:

(i) incorporate without acknowledge any material previously submitted for a degree or diploma in any institution of higher education;

(ii) contain any material previously published or written by another person except where due reference is made in the text; or

(iii) contain any defamatory material.

Matthew Wallace 8/02/02 *Date*

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CHAPTER ONE
INTRODUCTION

Background to the Study

A recent Industry Commission report in Australia estimated that the overall cost of work-related injures and diseases in 1992-93 was approximately $20 billion. This estimate equates to between $26 000 and $28 000 for each work-related injury, with the burden of cost rising with the severity of the injury. However, the workplace does not bear the total expense of such work-related injuries. Evidence suggests that the cost of work-related injury is shared between the workplace (30%), the injured worker (30%) and the community (40%) (Industry Commission, 1995). Furthermore, a recent report proposed that the cost of work-related injuries has not reduced in recent years (NOHSC, 1997).

From these findings, it is therefore evident that any reduction in the frequency and severity of work-related injuries will have far reaching economic advantages for both the workplace and the community at large. Such economic advantages of reducing work-related injuries have been identified by the Industry Commission (1995), including a redeployment of resources involved in dealing with the outcome of workplace injuries, an improvement in the productivity of the business; and reduction in workers' compensation premiums. In addition, it is not only compensation payments and increased insurance premiums that are borne out of work-related injury and disease, but also less tangible costs such as: production disruption, equipment damage and downtime, costs of investigating and reporting, lowered staff morale and adverse public relations. All of these factors have a negative impact on business and further promote the need for the development of incident prevention techniques. Due to the apparent complexity of injury causation, organisations have turned to occupational health and safety professionals to assist in the development of appropriate injury prevention techniques.

Occupational health and safety professionals themselves, have for some time grappled with the best method in which to reduce the number and severity of work-related injuries (Quinlan & Bohle, 1991). It has been recognised that in order to achieve favourable preventative outcomes, it is essential to understand the causes and contributing factors to workplace incidents. There are a number of different perspectives from which injury causation and prevention has been approached including; medical, behavioural and physiological (Quinlan & Bohle, 1991). The theories that have been generated from these perspectives identify individual employee behaviour as a critical component, although the emphasis placed on this factor varies.

The realisation that employee behaviour plays a significant role in workplace accidents has lead to a growth in a behaviour based approach to safety (Piscioneri, 1999). Behavioural based safety operates on the fundamental belief that every task, regardless of how safe its design, has a requirement of safe behaviours (Gilmore, 1997). In its most simplistic form, behavioural based safety involves the identification and listing of critical 'target' safe behaviours which are used by observers to measure compliance (Piscioneri, 1999). The reports ideally result in follow-up actions to increase safe behaviours, while decreasing or discouraging unsafe behaviours (Geller, 1996). With the greater focus on employees and their behaviour, the development of trust and ownership has been identified as critical for a program's success.

Employee involvement in occupational health and safety has for some time been espoused as an essential element in any occupational health and safety program (Walton, 1985). Furthermore, many supporters maintain that any safety management system is doomed to fail if employees are not involved in the establishment of the program (Krause, 1997; Geller, 1996). While various theories suggest that the involvement of employees will increase ownership, there is little research to suggest that employees have the ability to develop a valid and reliable means of tool to measure behaviours. This study aims to determine whether employees are able to develop a valid and reliable tool that focuses on behaviour. This study does not aim to validate behavioural based safety programs, but instead it aims to determine whether employees are able to develop a component of such programs. It is envisaged that the result will benefit all workplaces, not simply those who utilise behavioural based safety techniques.

Purpose of the Study

The primary purpose of this study is to provide preliminary evidence of content and construct validity of an employee developed checklist in measuring compliance with safe behaviours. This information can be used to allow workplaces to develop workplace specific, flexible measures of safety. Furthermore it will lead to greater involvement in and ownership of occupational health and safety for employees. Secondary to this, as one workplace has a safety incentive scheme in place, the impact of this on compliance with safe behaviours will be analysed. Furthermore demographic details of participants at the workplaces will de analysed in relation to compliance scores to determine whether there is any correlation. Associations identified within or between workplaces may provide information for future research in the area of occupational health and safety.

Research Questions

There are a number of questions that this study aims to answer. These questions are:

1. Does an employee developed tool demonstrate validity and inter-rater reliability when compared with a theoretically developed tool?
2. Does the employee-developed tool detect difference in compliance with safe work behaviours in settings with and without safety incentive schemes?
3. What are the relationships between the variables of age, experience and gender in relation to safety compliance scores?

Significance

Given the increasing high social and economic costs of occupational injury and illness to the Australian community, identification of initiatives to reduce the burden is urgently required. Paramount to reversing this trend is the need to identify and address the causes of the injury and illness. Although the significance of promoting a collaborative approach with employees that encourages involvement in safety has been identified, its relationship with safety performance still remains unexplored. Statistically significant results in this study will provide an opportunity for workplaces to develop and apply flexible, site specific measures of occupational health and safety that will allow for intervention prior to injury occurrence.

Through research of the literature, it is hypothesised that the employee-developed tool is a valid and reliable method for measuring compliance with critical safety behaviours in the workplace. Where the employee-developed tool is a valid measure, it will assist workplaces in involving their employees in goal setting to successfully decrease workplace incidents. When this can be achieved the costs incurred by workplaces, society and injured employees will decrease, which could potentially lead to increased profitability for organisations. Furthermore, any decreases in the frequency and severity of workplace injury has obvious benefits to all people engaged in work in Australia. The specific benefits for employees from this study is the ability to establish and control the standards of safe work, and the development of ownership and team spirit aimed towards improving occupational health and safety within a workplace.

Definition of Terms

A small number of acronyms have been used in this report. A brief definition of these has been provided to assist the reader.

EDC	Employee developed checklist. The checklist developed by employees and used in the study.
LTIFR	Lost time injury frequency rate. A standard measure of safety performance developed and used in Australia.
TDC	Theoretically developed checklist. The checklist developed from existing literature used to validate the EDC.

CHAPTER TWO

LITERATURE REVIEW

The philosophical framework, which underpins this study, is the assumption that employee behaviour is a critical control point in the accident causation process. Literature to support the development of this philosophy has been presented in this section. From simple beginnings the theories of accident causation are discussed to culminate in James Reason's Latent Failure Model of Accident Causation (1991) which provides the most comprehensive explanation of accident causation. Evidence from recent research on each of the components of the model is provided, along with its impact on occupational health and safety.

Following a detailed review of the accident causation model postulated by Reason, (1991) the ability for a workplace to control and measure the critical items in this sequence will be discussed to demonstrate the need to use a behavioural observation checklist. The use of a behavioural checklist could not be utilised without reference to behavioural based safety management techniques. As stated this study does not aim to validate these techniques, rather to utilise aspects of the process and philosophy of behavioural based safety. A brief overview of behavioural based safety has been provided, along with a discussion on workplace incentive schemes, an adaptation of behavioural based safety and the demographic variables that will be analysed in this study and their impact on occupational health and safety has been presented. Finally the importance of employee involvement will be discussed.

Measures of Safety Performance

In the past, determining good occupational health and safety performance has been difficult to measure accurately. The majority of currently used measures rely on outcomes (eg. incident or injury reports). For example, Lost Time Injury Frequency Rate (LTIFR) has long been regarded as the standard for the measurement of occupational health and safety performance (Gilmore, 1997). This measure has been referred to in the Australian Standard 1885.1-1990 (Standards Australia, 1990) and has been adopted throughout the world as the standard indicator of occupational health and safety performance (Gilmore, 1997). While measures such as LTIFR are easily attainable and definable, they have the potential to shift the focus away from the causes of accidents (Gilmore, 1997).

Another issue that has been identified with outcome measures is that they focus on consequences (i.e. after the fact), rather than measuring the factors that lead up to the consequences (Chhokar & Wallin, 1984). In effect, such measures focus on the lack of safety rather than the presence of it. These issues have focused the attention of safety practitioners to develop 'positive' measures of occupational health and safety. Positive measures aim to measure the presence of safety, rtaher than the negative consquence due to a lack of it (Geller, 1996). As a result, LTIFR and similar measures have come under scrutiny from occupational health and safety professionals and organisations (Krause, 1997; Geller, 1996).

The use of Lost Time Injuries and other outcome measures, provide little insight into the safety culture at a workplace (Krause, 1997; Geller, 1996; Kohn, 1993; Jacobs, 1970). Hence, Komaki, Barwick and Scott (1978) believe that infrequent events such as incident rates are unsuitable as an effective measure of a safety program. Furthermore, outcome measures such as LTIFR can be manipulated by external factors such as the presence of workplace rehabilitation. Chhokar and Wallin (1984) suggest that a measure based on the direct observation and recording of specific identified behaviours, gives an accurate measure of the organisation's safety performance. Evidence for this rests in the fact that all potential incidents (ie unsafe acts) are being recorded, rather than simply focusing on incident occurrences (Chhokar & Wallin, 1984).

The development of a flexible and positive measure of safety performance is constrained by a number of issues including the need for government, insurers and other external bodies to retain reliable and comparable statistics (Goodbourne, 1993). At the same time, organisations are being asked to seek more detailed statistics and measures that will indicate improvements quickly, so that they can be celebrated and reinforced (Geller, 1996). With the current 'outcome' measures of safety performance, an organisation may be incident free for a year before they see a vast improvement in their performance. In contrast, with 'process' measures such as compliance with agreed standards, an organisation can recognise improvements and correct deficiencies immediately.

The difficulties faced by governments and other bodies is that 'process' safety measures cannot be collected easily, whereas outcome measures are easily attainable from insurers, hospitals and State Workers' compensation Boards. While it is agreed there are significant hurdles preventing the implementation of 'process' safety measures across an industry, a number of organisations have found them to be a reliable and valid measure of performance (Krause, Seymour & Sloat, 1999).

There is a growing degree of support for 'process' performance measures, such as measuring behaviour, amongst safety professionals (Krause, 1997; Geller, 1996). However to fully appreciate the impact they have it is important to understand how incidents and injuries occur in a workplace. A review of accident causation theory has been presented to assist in this regard.

Theories of Accident Causation

Heinrich (1980) was the first to propose the concept that the unsafe acts of persons are responsible for a majority of accidents and that as many as 88% of accidents could be attributed to these unsafe acts. Heinrich's model is presented in Figure 1.

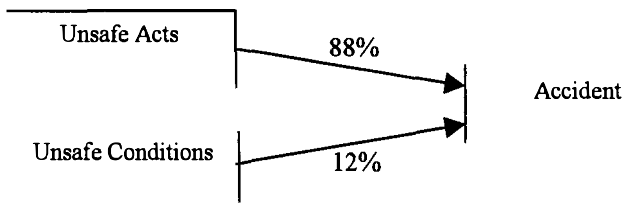


Figure 1 Heinrich's Model of Accident Causation (Heinrich, 1980)

A review of the literature on incident investigations and analysis techniques uncovers frequent reference to human error or unsafe acts as a contributing factor (System Safety Development Centre, 1995; Rothweiler, 1994; Harms-Ringdahl, 1993). Furthermore, recent research studies have validated Heinrich's original theory. An example of this is a study of 338 underground mining incidents, where it was found that human error by the injured employee accounted for approximately 80% of incidents and was judged to be a primary contributing factor in approximately 50% of all cases (Sanders & Shaw, 1988). Studies of road and air incidents have yielded similar results. Recent studies suggest that human error is a contributing factor in more than 80% of all motor vehicle and aviation incidents (Newman 1999; Evans, 1991).

Heinrich saw all workplace accidents as occurring due to either human error or the workplace environment; essentially 'unsafe acts' and 'unsafe conditions'. Since Heinrich first proposed his model, some experts have disagreed with his simplistic view of incident occurrence (Geller,1996). However, there remains a general consensus that control of the interaction between the worker and their environment is critical in the incident occurrence process (Geller,1996; Saunders and McCormick, 1992; Fitch, Herman & Hopkins, 1976; Grimaldi & Simonds, 1975). With the expansion of research in the area of occupational health and safety, current theory now provides a more complete view of incident causation.

Theorists built upon Heinrich's model and began to view workplace accidents as being a sequence of events. Adams (1976) was one of the earliest to extrapolate Heinrich's original theory into a process that allowed an organisation to identify contributing factors that led to an incident. In conceptualising his theory, Adams (1976) presented a model that identified four factors that generally lead to an injury, this became known as the Domino Theory. Adams' (1976) model is illustrated in Figure 2.

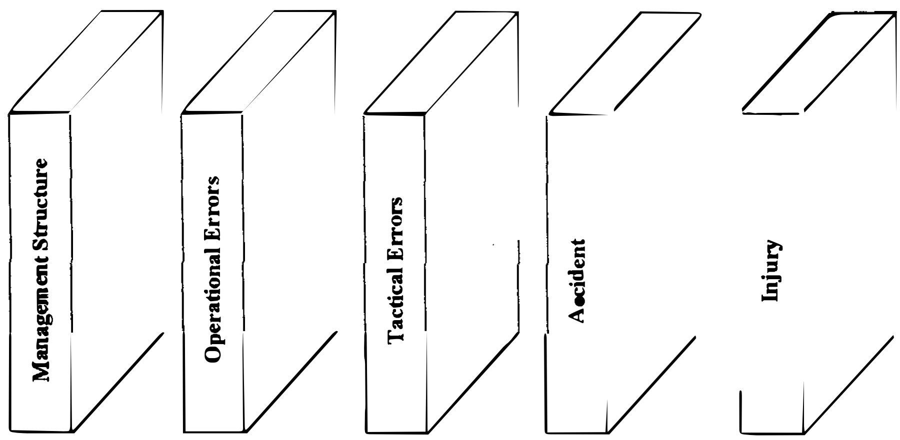


Figure 2 Adams' Domino Theory of Accident Causation (Adams, 1976)

Similar to poor productivity, Adams (1976) identified injuries as a symptom of wider organisational factors and viewed management structure as the manner in which the organisation manages the workplace. This concept includes both physical dimensions of the workplace and the manner in which work is performed. Operational errors are viewed as management, including supervisor behaviour, such as the amount of support and coaching offered, as well as the degree of delegation and initiative (Adams, 1976). On the contrary, tactical errors are the workplace conditions and employee behaviour (Adams, 1976). This is the link with Heinrich's model categorising unsafe acts and conditions as tactical errors. The next step in the sequence is an accident and the possibility of injury. The final step is where an injury occurs. Each domino in Adams' (1976) model can be seen as a control point. The theory supporting Adams' model is that an injury will not occur if any of the preceding factors (dominos) are removed. Hence, for optimum results, the organisation should endeavour to focus on the factors early in the process to give longer lasting impacts (Adams, 1976).

Another theorist of accident and incident causation, Reason (1990), built on the work of Heinrich and Adams to develop conceivably the most complete explanation of incident causation currently available. Reason (1990) summarises a wide variety of research that shows how organisational and individual factors play a role in the genesis of accidents. Reason's review shows how popular belief that accidents are due simply to isolated acts of human error masks the deeper story, a story of multiple contributors that create the conditions that lead to operator error (Reason, 1990). In short, Reason (1990) characterises errors as either active or latent. Active errors are described in terms of "slips, lapses, and mistakes, which are used to describe errors whose effects are felt almost immediately" (Reason, 1990: p56). In contrast, latent failures relate to errors whose adverse consequences lie dormant for a long time, becoming evident when they combine with other factors to breach the system's defences (Reason, 1990). Reason argues the notion that a number of system errors and decisions pre-date an incident, and it is only when these decisions and system deficiencies are 'aligned' that the full impact is felt by the organisation (Reason 1990). The arguments put forward by Reason provide a comprehensive and concise explanation of the latent factor model of how complex systems fail. Figure 3 provides an illustration of Reason's Latent Failure Model of Accident Causation.

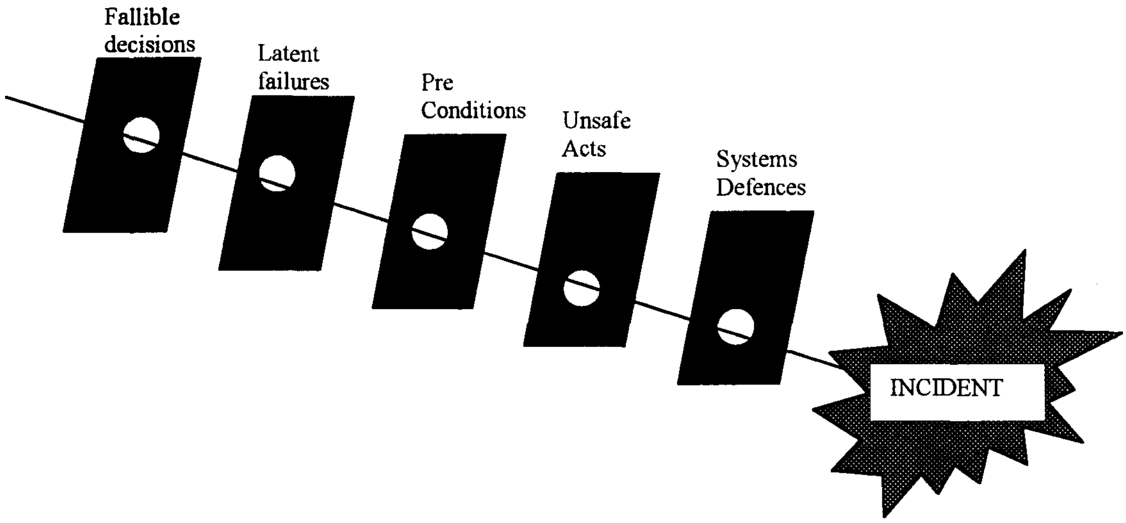


Figure 3 Reason's Latent Failure Model of Accident Causation (Reason, 1990)

The latent failure model captures beliefs that accidents are caused by the concatenation of multiple small failures, each necessary, although only jointly sufficient to produce an accident. This pattern of multiple contributors includes organisational factors that create the conditions for error, reduce error tolerance, or block error recovery (Reason, 1990). This pattern illustrates that there is no single cause for an accident, but multiple places where the chain of events could possibly have been broken.

Reason's Latent Failure Model of Accident Causation examines the impact of these organisational factors. Figure 4 illustrates the application of this model to an incident where a person was trapped by a forklift. For an incident to occur, Reason (1990) argues that people outside the workplace have made a number of fallible decisions some time ago. For example, such decisions may have been related to policy, design or purchasing decisions. Following this, further latent failures occur, such as management decisions to reduce the maintenance budget. As Reason (1990) describes, the impact of latent failures are not realised immediately and at this point an incident still will not occur unless a number of pre-conditions are present. Common preconditions may include weather, time, or pressure to complete the job. However, consistent with the domino theory discussed earlier, an accident may still not occur. At this point, if unsafe acts are committed, an incident is more likely to occur. The final step in Reason's model requires some breach of system defences. Therefore, it is only when each of these elements fail in the required manner, that an incident will occur.

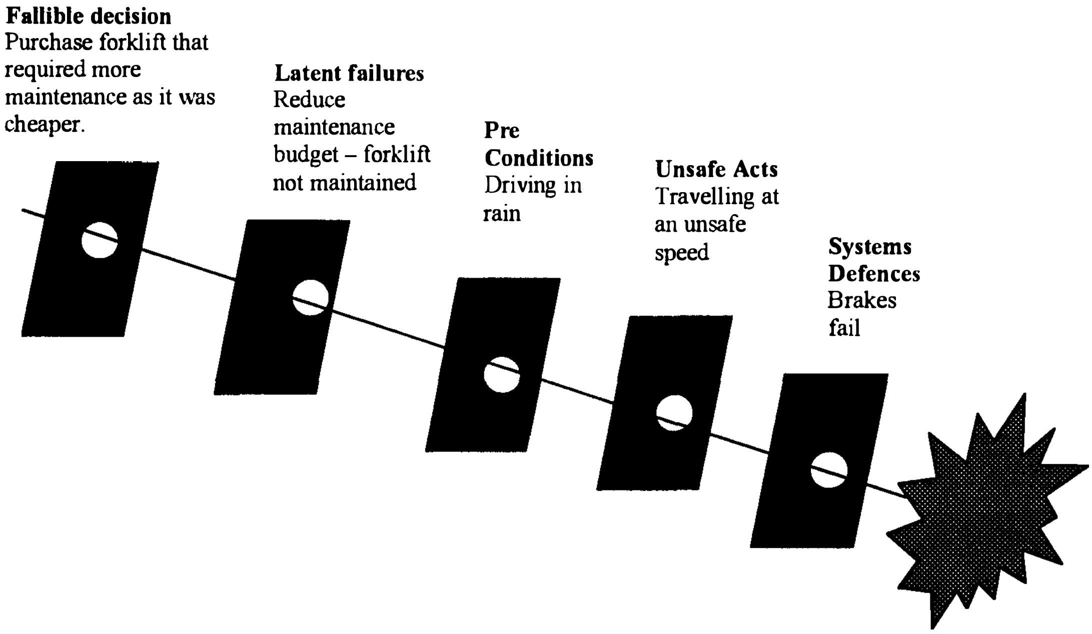


Figure 4 Reason's Latent Failure Model of Accident Causation applied to a forklift accident

The common belief that human error is the most common cause of accidents is a comfortable one that appears to provide sufficient closure to an accident. In essence, once culprits have been identified, they can be removed from practice or undergo remedial training, while new policies and procedures can be issued to keep other practitioners in line. While Reason (1990) does not support the notion that human error is the main cause of organisational incidents, he recognises it as an important control point. Therefore, if human error is reduced, the full impact of other organisational deficiencies will not be realised as an accident. However the deeper or root cause of accidents are a product of a broad range of organisational factors. The incident depicted in Figure 4 could have been prevented if any of the factors was not present. At a workplace level, the simplest to control, or remove is the 'unsafe acts'.

Recent Research Areas of Reason's Model of Accident Causation

A review of recent literature in the field of occupational health and safety has been presented to highlight the current understanding of a number of organisational and individual factors, and their relationship to Reason's (1990) Latent Failure Model of Accident Causation. The purpose of this review of the current school of thought is twofold. Firstly, it is to identify 'control points' within the incident chain, and secondly to discuss the potential that each factor may have on the outcome of this study. Control points have been defined by the researcher as points in a system that are able to be controlled and quickly rectified by simple and inexpensive means. This definition has been applied to indicate where organisations should focus in order to appreciate immediate improvements in occupational health and safety performance. While, it may not be possible to capture all factors that contribute to accidents, recent research findings have been summarised and incorporated into the Reason's (1990) Latent Failure Model of Accident Causation and illustrated in Figure 5. The illustration of the factors that impact on both unsafe acts and conditions in a workplace provides an understanding of the complex interaction of potential contributing factors involved in any workplace incident. In some cases, factors may interact or be inherently linked to others in the figure. For example, a young person at a workplace may exhibit different beliefs about the workplace and have little or no expertise in the task. In this example, both 'workplace culture' and 'expertise in the task' are inherently linked to age. However, for easier comprehension, each factor has been discussed individually where possible.

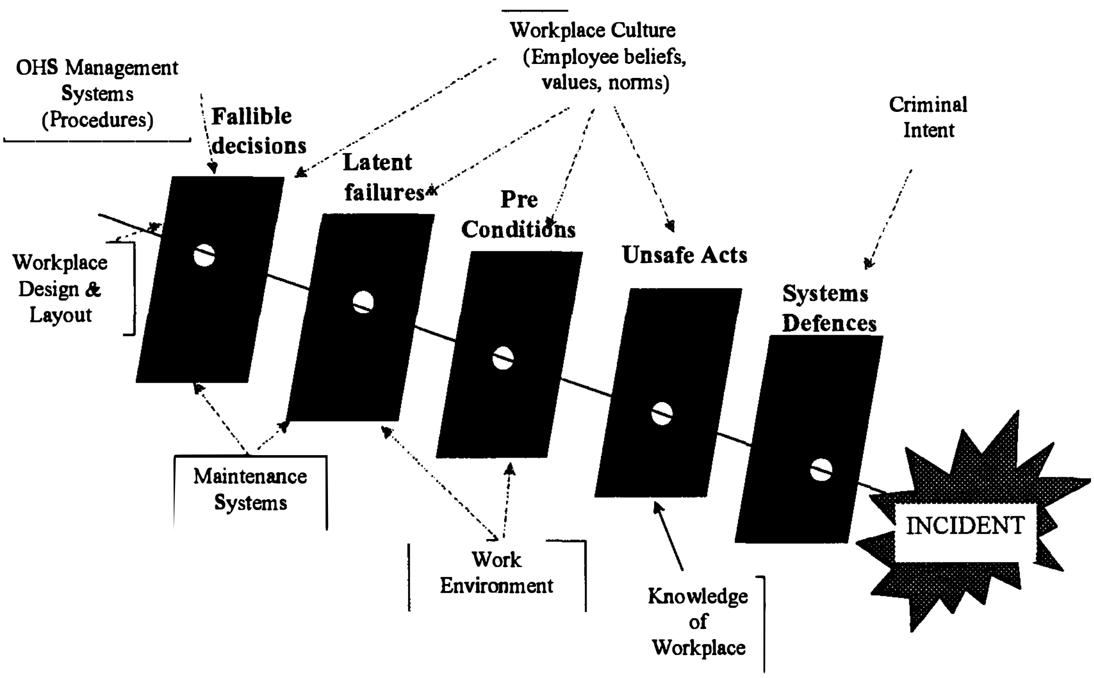


Figure 5 Overview of Recent Research Areas of Reason's Model

Workplace layout & design

Reason's (1990) Latent Failure Model of Accident Causation focuses on both unsafe acts and unsafe conditions. It would consequently be erroneous to discuss incident causation without focussing on one of the most visible causes of unsafe conditions. In this study, the term workplace layout and design is given to a wide range of organisational issues that potentially may impact on the ability of an individual to perform work in a safe manner. Such factors may include the physical dimensions of the workplace, design of tools and equipment, and/or the work organisation (eg. shiftwork). For example the physical dimensions of a workplace may impact on an employee's ability to perform manual handling tasks in a safe manner. In addition, the physical dimensions of the workplace may increase an exposure to environmental factors (eg. noise, climate etc.), which have long been associated with workplace injuries and illnesses (Sanders & McCormick, 1991). Similarly, equipment design may impact on injury and illness in numerous ways. This may be through poorly designed equipment that prompts incorrect responses from individuals (Sanders & McCormick, 1991) and secondly, equipment that emits high levels of noise, radiation and/or environmental contaminants may potentially have an impact on employee health and safety (Grantham, 1992).

Although there is an urgent need for empirical research into the impact of physical dimensions of a workplace and equipment on incidents, little research has been conducted to date (Sanders & McCormick, 1991). Whilst standards have been developed by governments outlining particular aspects of design that may potentially impact on occupational health and safety, the ability of these standards to incorporate rapidly changing technologies remains uncertain. Furthermore, the costs of addressing design issues are significant and consequently organisations may view such interventions as long-term control methods.

Although occupational health and safety experts view the physical environment as consequential when discussing workplace layout and design, the ability of an individual to make safe decisions is of equal importance. The method in which work is organised may significantly impact on the ability of an individual to perceive and process information pertaining to workplace hazards (Quinlan & Bohle, 1991). Unlike the physical aspects of workplace design, the method in which work is organised has drawn much attention from researchers in the past. The major focus of this research has been into the impacts that shiftwork has on the likelihood of workplace injuries and illnesses.

Shiftwork and extended hours of work have been associated with significant occupational health and safety risks (Fletcher & Dawson, 1997). Non-standard work hours have been found to contribute to the reduction in both the duration and quality of sleep, which is known to adversely affect alertness and cognitive performance (Dijk, Duffy & Czeisler, 1992). These factors have been associated with increases in incidents as well as other costs at both the macro (social) and micro (organisational) level (Leger, 1994). Research has indicated that night workers in particular are most susceptible to periods of extreme sleepiness and the lack of ability to think clearly during the early morning hours (ie between 3 and 5 am) (Fletcher & Dawson, 1997). It is at this point that the potential for falling asleep or an error in judgment may result in anything from substandard quality product to a major industrial accident (Fletcher & Dawson, 1997). Some of the most notorious industrial accidents (Three-Mile Island, Chernobyl, and the Exxon Valdez) occurred during these early morning hours, with human error playing a key role in each of them (Fletcher & Dawson, 1997; Leger, 1994; Sanders & McCormick, 1991).

It must be acknowledged however, that the effects of shiftwork are not limited to physical injuries as a result of incidents. Shiftwork, or similar systems of work that require an employee to function when they would normally be asleep, can disrupt the body's circadian rhythm (Reid, Roberts & Dawson, 1997). Circadian rhythms are vital in that they dictate the basic body functions, including cardiovascular and respiratory function and blood pressure (Reid et al., 1997). Although there are many biological rhythms, sleep and wakefulness are the most important for shiftworkers. As a result of this disruption in the body's rhythms, shiftworkers and former shift workers exhibit more signs of ill health than people on fixed day work (Reid et al., 1997). In a study of nurses working shiftwork in South Australia (Lushington, Lushington & Dawson, 1997), a higher than expected incidence of gastrointestinal and digestive disorders and depression, was observed in the study population (Lushington et al., 1997).

Although the above research indicates an association between shiftwork and workplace injuries and illnesses, the extent to which specific factors such as the duration of shifts, recency and rotation of shifts, and the residual tiredness prior to beginning shifts are important, has been less well established (Fletcher & Dawson, 1997). If a link between residual tiredness prior to beginning a shift is established, the potential to decrease incidents will extend far beyond the organisation that employs shiftworkers. The workplaces involved in this study worked in a fixed roster system, therefore without further research, the ability to measure and analyse factors such as residual tiredness is limited. For this reason, this factor will not be measured in this study.

Work environment

Environmental factors have the potential to impact on incidents in a number of consequential ways. Firstly, environmental factors such as noise, vibration, extreme temperatures and atmospheric contaminants, may directly cause illnesses to individuals within the workplace. Studies conducted in the United States indicate that more people die each year as a result of occupational illness and disease than occupational injuries (Driscoll, 1993). Many of these causes have been linked to design and layout of the workplace (Grantham, 1992). Secondly, environmental factors have the potential to impact on an employee's ability to perform the work in a safe manner (eg. extreme cold will impact on an employee's ability to grip objects, high background noise can affect concentration). As a result, both direct and indirect injury impacts need to be considered when examining any relationship between environmental factors and workplace injury and illness.

Work environment, as previously discussed with shiftwork, has the potential to manifest itself as both traumatic accidents and also occupational disease. Often in the field of occupational health and safety, focus is placed on injuries rather than illnesses (Grantham, 1992). Workplace factors such as noise, vibration, temperature extremes, radiation and the use of chemicals have been directly linked with a number of diseases in the past (Mathews, 1985; Driscoll, 1993).

Although research suggests that occupational illnesses cause more deaths each year than occupational injuries, measurement of the prevalence of occupational disease is difficult due to the inconsistent use of terms, both within and between systems (Driscoll, 1993). For example, criteria used to define occupational disease by the International Epidemiological Association, the International Labour Organisation (ILO), the United States Bureau of Statistics, and the National Occupational Health and Safety Commission of Australia, differ (Discoll, 1993). These organisations differ based on varying degrees of: the type of exposure, length of time of the exposure, and time between the exposure and the visible sign of illness (Driscoll, 1993). For example; the ILO accepts that a single exposure to asbestos can result in asbestosis or mesothelioma, whereas both the USA and Australia require longer exposure to asbestos at work before they will record the asbestosis as an occupational disease. Furthermore, Grantham (1992) argues that difficulty in the measurement of occupational illness is due to an inability to link the illness to a workplace, due in many ways to long latency periods (eg. asbestos, occupational cancers). However, while the extent to which the workplace impacts on illness and disease may be under reported, the presence of a correlation has long been established (Grantham 1992).

Although environmental factors play a significant role in directly causing disease, the impact that environmental factors have on employee performance is of equal importance. The effect of environmental factors on performance has been the focus of numerous studies. Many of these studies have focussed on the physiological and psychological impact that environmental factors have on employees. Ramsey and Kwon (1988) found that performance on complex tasks decrease significantly when the temperature at the workplace is greater than 33 degrees. Similarly, studies have found that colder temperatures can also negatively impact on manual performance and reaction time (Enander, 1989).

While the findings from these studies have impact in the workplace, the impact they have on the prevalence of safe behaviours or incidents is not as clear. Although, a study on the effect that climatic condition has on safe behaviour yields some relevant and interesting preliminary results (Ramsey, Burford, Beshir, & Jensen, 1983). Ramsey et al (1983) found that in a fourteen-month study where over 17,000 observations were made, safe behaviours were more prevalent when temperatures were between 17 and 23 degrees (WBGT).

The impact that environmental factors other than climate, have on physical performance in the workplace is less clear (Sanders & McCormick, 1992). A study by Davies and Jones (1982) concluded that the detrimental effects of noise and vibration are usually associated with tasks performed continuously and tasks that place high demand on perceptual and intellectual capacity. Conversely, some studies have found that background noise can actually improve performance on other tasks (Sanders & McCormick, 1992). Results of studies on the detrimental effects of noise and vibration yield different findings, and as a result only guarded conclusions regarding the impact of environmental factors, such as noise, can be taken from studies conducted.

Although it is evident that environmental factors may contribute to poor performance outcomes, the control a workplace has over such factors is limited. Climatic conditions can be regulated by the workplace to some degree, however, the workplaces examined in this study do not have a great deal of direct control over such factors. While studies have supported the theory that climate variations may impact on performance, the effect that a work environment has on the performance of safe behaviours will not be measured in this study due to the complexity it would add.

Knowledge of workplace

It has been suggested that a lack of knowledge of a workplace can impact on the presence of unsafe acts that may ultimately lead to incidents (Mayhew, 2000). The knowledge people lack may be in the form of work practices and procedures unique to the workplace, or a lack of knowledge of the layout of the workplace. It is for this reason that a critical aspect of an organisation's safety management system is making people aware of the hazards through workplace induction training. Furthermore, research has found a link between length of employment and knowledge of workplace processes. In a fifteen-year study, Dell and Blerkout (1998) found that a reduction in workplace accidents was attributable to longer periods of employment as well as greater knowledge of work processes. Mayhew, Young, Ferris and Harnett (1997) support this notion, and suggest that contractors are the most likely group to be exposed to a lack of knowledge of individual workplaces.

Contractors are frequently strangers to a workplace and are unfamiliar with workplace practices and the activity of other workers (CCH, 1998). In addition, the wide variety of sites that a contractor may frequent, all with different procedures and practices, may create confusion for the contractor (CCH, 1998). As such, contractors form a unique population on which to measure as well as illustrate the impact that a lack of knowledge of a workplace has on workplace accidents.

The use of outsourced, or contract labour has been linked to poorer occupational health and safety outcomes in various industry sectors across a number of countries (van Waarden, den Hertog, Vinke & Wilthagan, 1997). A comparison of injury patterns between outsourced labour and employees provides clear evidence of the gap between contractor occupational health and safety performance and the performance of a more stable workforce. Studies conducted in the United States and United Kingdom found that contractors and subcontractors accounted for 2-3 times more injuries than would be expected, based on their percentage of the labour market (Mayhew et al., 1997). Australian fatality statistics indicate that self-employed persons, many of them contractors, are more than twice as likely to be killed at work than employees of an organisation (CCH, 1998). Similar patterns of serious injuries have been seen for contractors in industries such as construction, mining and clothing manufacturing (CCH, 1998). Interestingly, evidence suggests that the risks do not extend only to contractors themselves, but also those working near them. A Victorian study found that the presence of contractors was associated with an inordinate number of occupational fatalities (CCH, 1998). The search for reasons for this disparity in occupational health and safety performance of the transient workforce has resulted in a number of studies in this area.

A number of hypotheses have been postulated to explain the disturbing trends associated with contractors and injury occurrence. It is argued that the four factors linked to the poorer occupational health and safety performance of contractors include economic pressures, a lack of knowledge of legislation and safe work practices, disorganisation, and diminished regulation (Mayhew, Quinlan & Bennett, 1996; Salminen, Saari, Saarela, Rasanen, 1993). Mayhew et al. (1997) believe that while organisation may tend to contract out the hazardous tasks, the major reason for the high incidence can be related to a lack of knowledge of the workplace and/or legislation. It would therefore seem that an increase in awareness of workplace and legislative occupational health and safety requirements may produce better safety performance of the contractor workforce.

In many organisations today, induction training is conducted to increase the awareness of new employee and contractors to the hazards and safe work practices. Training is an essential element for achieving knowledge of a workplace (Mayhew, 2000). "Safety awareness does not come naturally – management must teach, motivate and sustain employee safety knowledge to eliminate injuries" (Dupont, 1995, p34).

Other literature argues that, without adequate information about hazards, legislative requirements and skills development, employees are unable to function safely and effectively (Hopkins, 1994).

Evidence supports the notion that an individual's knowledge of workplace practices and process are a contributing factors in workplace incidents. Incident rates and self-reports of contractors have been used to identify this theory (Mayhew et al., 1997). Due to the limited tenure of many contractors, they will not meet the criteria to be included in this study. However information on the length of employment can be easily obtained and will be used to obtain data on an individual's knowledge of the workplace.

Workplace culture

For some time industry and researchers alike have been interested in the concept of corporate culture and its effect on organisational performance (Shaw & Blewett, 1996). The culture of an organisation can be described as "the mix of shared values, attitudes and patterns of behaviour that give the organisation its particular character –put simply it is 'the way we do things around here'" (CBI, 1990, p6). It stands to reason that, if organisations have a culture or a way of doing things, that this must also encompass health and safety. Thus the 'safety culture' of an organisation may be viewed as a summary concept describing the safety ethics in an organisation reflected in employee beliefs about safety and hence the way employees behave with respect to safety in that workplace (Williamson, Feyer, Cairns & Biancotti, 1997).

In one of the first investigations into 'safety culture', Zohar (1980) found that management commitment to safety was a major factor affecting the success of safety programs in organisations. Zohar (1980) also found that this commitment manifested itself through job training programs, participation of management in safety committees, the consideration of safety factors in job design, and the reviewing of the pace of work. Since this time, other authors have discussed the influence of safety culture on the incidence of accidents (Shaw & Blewett, 1996; Hofman & Stetzer, 1996; Owen, 1996). The underlying theme of such literature is that individuals attach meaning to, and interpret the environment within which they work. These meanings and perceptions then influence the attitudes of individuals and the way in which they behave within the organisation (Hofman & Stetzer, 1996). For example, individuals working for a supervisor who never mentions safety might perceive that safety is not important, and as a result, will themselves not place a strong emphasis on safety (Hofman & Stetzer, 1996.). Figure 6 summarises the relationship between culture and occupational health and safety activities.

OHS CULTURE

VALUES	**BELIEFS**	**NORMS**
'what is important about OHS'	'how things work in relation to OHS'	'the way we do things about OHS'

OHS ACTIVITES

Figure 6 Relationship between OHS Culture and OHS Activities (Hofman & Stetzer, 1996)

Safety culture requires two key aspects to be present to ensure the delivery of desired results, employee and management commitment (Barnes, 1993). Employee commitment can be encapsulated as the perceived control an individual believes that they have over their own safety at work and has also been termed 'locus of control' (Barnes, 1993). Janicak (1996) proposes that if an employee believes they have the ability to positively impact on the health and safety of themselves and others, they are more likely to work in a safe manner and less likely to be involved in an accident. However it has been realised by numerous authors (Krause 1997; Geller, 1996; Goodbourn, 1995) that employee commitment cannot, in itself, create significant change in the workplace. Management must also be committed to providing and maintaining an environment that supports employees and occupational health and safety outcomes. This is the second component of a positive safety culture. Full integration of health and safety practices into the management functions of planning, organising, leading and controlling as routine practice, is seen as essential for achieving a safety culture (Barnes, 1993). A Confederation of British Industry study also reinforced that a high standard of health and safety should be a key and integral part of good business management (CBI, 1990). Several of the organisations in the Confederation of British Industry study recognised that safety is too often seen as an activity that could be added or ignored according to the pressure of other factors. Instead, the organisations maintained that, if safety is really as important as production and quality, it must be managed in the same way with the line of responsibility unbroken from the top of the organisation to the bottom (CBI, 1990).

A recent article in the publication '*Workwords*' put out by the Victorian WorkCover Authority, described research conducted by the Operations Management Division. This research identified the integration of occupational health and safety into broader workplace management as the key to improving performance (Victorian WorkCover Authority, 1999). Gallagher found that senior management leadership was a vital driver of this integration, as senior management were in a position to allocate resources and to include safety in broader business planning as well as the day to day activities of the organisation (Victorian WorkCover Authority, 1999). The importance of management commitment to occupational health and safety has been observed in a number of studies (Bellamy et al., 1994; Dedobbeleer & Beland, 1991; CBI, 1990) and it is vital that the commitment by management to occupational health and safety is sustained, genuine and demonstrated. However, Ivancevich, Olekalns and Matteson (1997) caution that it is difficult to simply create core values and when disparity exists between reality and a stated set of values, employees become sceptical (Ivancevich et al., 1997). While there is consensus on the importance of a safety culture, the improved safety performance as a result is critical to its success.

In the Australian coal mining industry, management commitment to safety performance is one of the major factors associated with the declining trend in injuries, fatalities and disease (Ore, 1992). Hastie (1998), compared the workers' compensation premiums of two large Queensland retailers, and concluded that it was the sustained commitment of one's senior management to risk management and rehabilitation that led to its superior performance. DuPont, is one company renowned for its commitment to safety and is considered to be a world leader in the field. This commitment has led to two basic philosophies:

- All accidents and injuries can be avoided
- Occupational health and safety is a line management responsibility commencing with the CEO (Dupont, 1995, p8).

Between acquiring its Bayswater plant in 1989 and 1993, Dupont improved its safety performance considerably through adhering to this philosophy (Dupont, 1995). Dupont

(1995) was able to foster a culture in which employee and management both had a vested interest in safety.

It is critical that employee commitment and management commitment is shared. One of the keys to improving health and safety attitudes is involving individuals in the decisions made at work which affect their working environment (Reith, 1998). There is a growing body of evidence to suggest that a favourable management-labour relationship is positively related to safety performance (Randolph & Peters, 1990).

The power of culture can be also be observed in organisations in which employees share the belief that accidents and illness are an inevitable consequence of the industry – reinforcing the acceptance of high injury and disease rates (Shaw & Blewett, 1996). In their study, CBI (1990) noted that several companies stated they had to overcome long held attitudes and myths such as 'some people are just accident prone' and that 'there isn't time for frills like safety.' In their research in developing a measure of safety culture, Williamson and colleagues (1997) included a 'fatalism' dimension reflecting views of the controllability of safety. Safety culture, being a collection of individual beliefs and values, and workplace norms, encompass many of the other factors identified as contributing to incidents (Williamson et al.,1997). The scope of this study does not allow for an in-depth analysis of safety culture, however the presence or absence of safe work behaviours as measured in this study may be characteristic of this.

Occupational health and safety management systems

The systems approach to managing occupational health and safety has become prominent in Australia over the last decade (Quinlan & Bohle, 1991). This approach, aims to develop a systematic way to identify, assess, control and monitor hazards in the workplace. Occupational health and safety management systems generally cover areas of a business such as: training, supervision and skill development, incident reporting, risk management and equipment purchasing procedures (NOHSC, 1994).

The systems approach along with performance style legislation has lead to an increasing number of formal policies and procedures relating to occupational health and safety management. The extent to which the presence and quality of health and safety management systems impacts on workplace injuries and illnesses, is extremely difficult to assess. However, it is argued that the presence of occupational health and safety systems that are integrated into a business is associated with optimal occupational health and safety performance (NOHSC, 1994).

While there is a potential link between occupational health and safety management systems and improved performances, the lack of empirical evidence creates some uncertainty in this regard. For this reason, and also due to the subjectivity involved in measurement of occupational health and safety management systems, the presence of such a system will not be measured in this study.

Maintenance systems

The relationship between workplace layout and design and unsafe conditions has been discussed. However, maintaining a safe work environment is of equal importance to the design and layout of a workplace. It is critical to discuss the impact that maintenance of workplace equipment has on incidents. Maintenance is often categorised as either preventative or breakdown. The difference between these two categories is that preventative maintenance is often scheduled to occur on a regular basis, whereas breakdown maintenance is rectifies an identified problem or fault with machinery or equipment. To date, there exists little empirical research that measures the effect of maintenance on occupational health and safety. However occupational health and safety authorities and professional bodies have recognised the important roles that maintenance plays in an effective occupational health and safety management system.

A review of six Australian occupational health and safety management systems audits identified that maintenance of plant and equipment is a crucial component in providing a safe workplace (refer National Safety Council of Australia 5 Star Safety Audit; National Occupational Health and Safety 5 Star Safety Audit – South Africa; Safety Map Audit Tool - Victoria; Tri Safe Audit Tool - Queensland; AS 4804; Safety Achievers Bonus Scheme Audit - South Australia). All of these audit tools focused on differing degrees of the importance of regular, scheduled maintenance of plant and equipment. While little empirical research has been conducted into maintenance and its impact on occupational health and safety performance, the focus that legislation and numerous occupational health and safety audit tools place on it, indicates that there may be some relationship between maintenance and safety performance. While there may be an obvious link between poor maintenance and workplace accidents, there is a deficiency of research and tools to measure the extent to which this factor contributes to workplace accidents. For this reason, it will not be measured in the study.

Criminal intent

In some workplace incidents the injury is caused by a conscious attempt by one individual to harm another (Flannery, 1996). This discussion will be limited to those incidents where there is intent to cause harm as distinct from harm caused by breaches of OHS legislation that unintentionally caused harm. While these behaviours and actions still constitute a crime, the level of intent to harm cannot easily be determined. Therefore, the term criminal intent used in this section refers to those incidents that are generally agreed to be beyond the control of the employer or the injured employee (Flannery, 1996). Injuries sustained from occupational violence and armed robbery are common examples of such incidents.

A study during the past decade into work-related fatalities in Australia, found that fifty (50) individuals were killed as a result of deliberate acts of violence by other individuals between 1989 and 1992 (NOHSC, 1998). While deliberate acts of violence were responsible for a small proportion of the total work-related fatalities during that time, the proportion had increased by 45% since 1984 (NOHSC, 1998). Furthermore, this study indicated that work-related fatalities involving males were more than twice the incidence compared to females, and even higher for older employees (NOHSC, 1998). This study found that the industries most affected by this increase were; retail, transport and storage, agriculture and business services (NOHSC, 1998). The most common apparent motives identified were robbery, assault and premeditated murder (NOHSC, 1998). Recent research in Finland is consistent with the finding of the Australian study (Saarela & Isotalus, 1999). In telephone interviews with 80 000 workers, 4.1% revealed they had experienced violence, or a threat of violence at work in the last 12 months (Saarela & Isotalus, 1999). Furthermore similar risk groups were identified (Saarela & Isotalus, 1999). These research findings would suggest that incidents arising from criminal intent are an emerging issue for workplaces in Australia.

While the issue of workplace violence may be a recent emergence in Australia, it is well embedded and a significant problem in workplaces in the United States. Homicide, due to workplace violence, is the leading cause of death for women in the workplace and the second leading cause of death for men (United States Department of Labour, 1995). Statistics indicate that 44% of workplace attacks are committed by customers or clients, 24% by strangers, and 20% by co-workers (Flannery, 1996). Only a small number of people are convicted of homicide within the workplace (Flannery, 1996).

Although standards of injury recording and legislation may prevent a direct comparison between Australian and United States data, there is little doubt that occupational violence is becoming a greater contributor to workplace incidents. This notion is supported by recent legislative changes in Australia, whereby a number of state authorities have developed 'Codes of Practice' and 'Guidelines' related to workplace violence (for example Western Australian Code of Practice for Occupational Violence).

The difficulty in identifying such a factor as contributing to incidents relies heavily on the quality of incident investigation as well as an organisation's ability or desire to gather sufficient information to establish such a relationship. For these reasons, criminal intent will not be measured in any way throughout this study. The above information relating to the frequency of occupational violence and its relationship to workplace accidents would suggest that excluding this factor will have little effect on the outcomes of this study.

The above discussion presents a number of factors that contribute to unsafe acts and conditions that in turn may lead to workplace incidents. Of the factors presented that link to unsafe acts, all rely on human behaviour to impact on incidents. For example, lack of knowledge of a workplace (factor) may contribute to an incident only when a task (behaviour) is performed that is beyond the individual level of skill. Without the presence of behaviour the factor will not lead to an incident. Reason's model, however, does not indicate why these factors elicit certain behaviours. Why do contractors exhibit more unsafe behaviour than employees? A greater understanding of the reasons for behaviours can be gained by examining the various theories of motivation must initially be traced.

Theories of Motivation

Numerous psychologists have attempted to explain why people act in certain ways. And as a result many would argue that humans are motivated not necessary by reason and free will to act in certain ways (Bernstein, Roy, Scrull & Wickens, 1991). Furthermore, one thing is for sure, motivation is a complex phenomenon that impacts on all areas of human behaviour (Berstein et al., 1991). A number of theories have been developed to explain this process, all of which have impact on an employees behaviour at a workplace. These theories can be placed into two categories: intrinsic and social theories.

Motivational theories grouped as 'intrinsic' assume that human behaviour is driven by needs within the person (eg. a person eats because they feel hungry). Alternatively, some psychologists believe that people are motivated by external or social factors (for example when people enter an elevator they turn and face the doors because that is the norm). No single theory provides a complete explanation of why humans behave in certain ways, yet each offers an important perspective on human behaviour. As with the theories of accident causation, motivational theories have developed into complex models. A brief overview of intrinsic and extrinsic theories has been discussed to provide an overview of two schools of thought.

'Intrinsic' Theories of Motivation

Intrinsic theories have the common thread of a biological need to maintain a balance (Bernstein et al., 1991). This tendency for humans (and animals) to keep their physiological systems at a steady level is referred to as 'homeostasis'. It is argued that humans have an innate need to maintain homeostasis, therefore dictating their behaviour (Berstein et al., 1991). Imbalances in homeostasis create a 'need', which turns into a 'drive' which is a prompt for the person to restore balance (Berstein et al., 1991). For example, if a person has had no water for some time, the chemical balance of the body's fluid is disturbed, creating a biological need for water. The consequence of this need is a person's drive to quench their thirst. This drive motivates a person to find and drink water. After drinking, the need is satisfied and the drive is reduced, returning the body to homeostasis.

Further research into the area of motivation has lead researchers to look deeper into the causes of human behaviour. The results suggest that homeostasis theories of behaviour cannot adequately explain behaviours such as mountain climbing and behaviour associated with curiosity (Deci cited in Berstein et al., 1991). These identified deficiencies lead people to think of motivation in terms of arousal. Arousal theories of motivation propose that people are motivated to behave in ways that are, for them, an optimal level of arousal (Berstein et al., 1991). Essentially, people are motivated to increase their level of arousal when it is too low and decrease it when it is too high. The optimal level of arousal is different for each individual. The implications this has for the workplace are that some people (due to a high requirement for arousal) will continually look for ways to increase their level of arousal. This may be achieved through exhibiting more risk taking behaviours.

The theory of arousal has been used to explain why people exhibit risk taking behaviours in motor vehicles. It is argued that with the introduction of safety features such as seat belts, air bags, anti lock braking people compensate by taking greater risks (Deery, 1999). Stetzer and Hofmann (1996) undertook a study of behaviour to determine whether drivers compensated for safety features in vehicles. The results from Stetzer and Hofmann's (1996) study supported this assumption. It was found that participants acted differently to environmental cues when they were in 'safer' vehicles (Stetzer and Hofmann, 1996). The study also found that participants adjusted their speed to maintain a level of arousal (Stetzer and Hofmann, 1996).

In summary, intrinsic theories of motivation focus on the physiological or psychological needs within a person. These theories attribute all behaviour to the need to satisfy a deficit which may be either physiological (eg. eating and hunger) or psychological (eg. speeding to maintain level of arousal). Although intrinsic theories of motivation explain why people behave in certain situations, these theories do not adequately explain the occurrence of habits. Social theories of motivation can better explain such behaviour.

Social Theories of Motivation

Social theories of motivation explain behaviour in terms of responses to environmental stimuli (Bernstein et al., 1991). In essence, this means that behaviour is essentially goal orientated; that is, behaviour is directed towards attaining positive outcomes and avoiding negative ones (Kohn, 1993). Watson, considered the father of behaviourism, first introduced his ideas on motivation in the early 1900's (Bernstein et al., 1991). He believed that human behaviour is the result of conditioning arguing that humans learn to behave in certain ways (eg. form habits) to achieve a positive outcomes.

During the mid 1900's other behavioural theorists developed and marketed the importance of behaviourism. One of the first to do this was Skinner who progressed the importance of behaviourism through successful experiments dealing with operant conditioning (Bernstein et al., 1991). Although Skinner performed his experiments on animals, he argued the theory was able to be generalised to humans. Operant conditioning is the concept that everything in one's life produces a consequence. As Kohn (1993) describes "do this and you will get that" (Kohn, 1993; p 12). Many behaviourists argue that if the consequence is appreciated, or if it is positive or pleasurable, the behaviour is more likely to be repeated. Likewise, if a consequence is negative, a repeat behaviour is less likely to occur. The power of a reinforcer depends heavily on the expectancy and value of the consequence it will bring. Interestingly, Skinner developed his theory of operant conditioning at the same time that Heinrich developed his theory relating to unsafe acts and workplace incidents.

Social theories of motivation and learning rely on two constructs of expectancy and value. In short, if a person expects a particular behaviour to lead to a positive outcome, deemed to be valued, the person will be motivated to exhibit that behaviour (Kohn, 1993). Conversely, if a person expects a behaviour will lead to a negative outcome, deemed not to be valued, the person will be less motivated to exhibit the behaviour (Kohn, 1993). Constructs of expectancy and value are particularly applicable to the workplace environment. What is it that motivates people to perform work in an unsafe manner? Sulzer - Azaroff (1987) observed that unsafe practices within the workplace persist because they are somehow naturally reinforced. To gain a greater understanding of this concept, the outcomes of unsafe acts in terms of value and expectancy, will be examined.

While unsafe acts potentially lead to incidents (negative consequence), in most cases an incident will not eventuate. In practice, unsafe behaviour rarely results in an injury. In a well known study of workplace injuries, it was found that less than 5% of unsafe acts resulted in any negative outcome (eg. near miss, property damage or injury) (Heinrich, 1980). More recent literature confirms that natural negative reinforcers for unsafe acts, are often delayed, weak or infrequent (Geller, 1996). It is therefore argued that the expectancy of an incident occurring, following an unsafe act, is low. While the social theories of motivation maintain an incident would be given a high (negative) value, the low expectancy will inhibit motivation to perform work in a safe manner. On the contrary, expected outcomes of working in an unsafe manner may include praise or financial gain for completing a task quickly and personal satisfaction. If these outcomes are valued as high, one could argue that the person would be more likely motivated to perform work in an unsafe manner due to the expectancy and value of the outcomes. This social theory of motivation is illustrated in Figure 7 where the thicker line represents more likely motivation. Since the 1980's there has been a resurgence of the behaviour based approach to safety (Piscioneri, 1999).

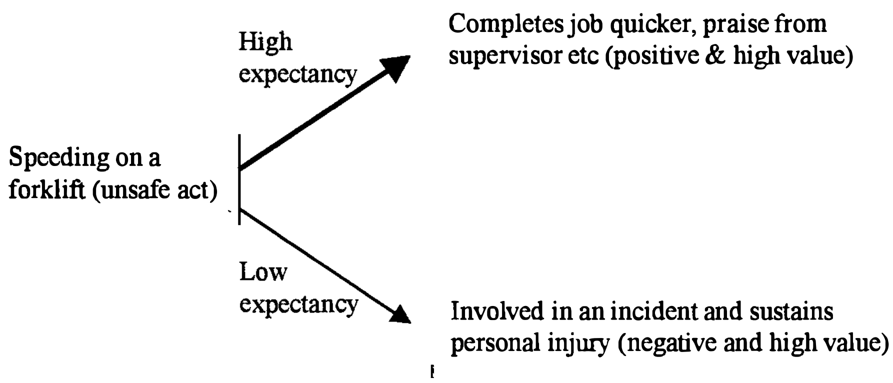


Figure 7 Social Theory of Motivation Applied to a Workplace Scenario

Behavioural Safety Management

While the original concept of behaviour based safety was viewed as an isolated system and labelled as 'victim blaming', supporters of the latest resurgence of behavioural based safety view it as an aspect of a broader approach to safety. Such is the support for behavioural based safety that a review of ten common, but different approaches to safety management, found behavioural based approaches as the most effective in providing structures for reducing injuries (Geller, 1996).

Behavioural based safety operates on the fundamental belief that every task, regardless of how safe its design, has a requirement of safe behaviours (Gilmore, 1997). Behavioural based safety focuses on the prevention of unsafe acts and the measurement or quantification of safety, based on observable safety related behaviours (Gilmore, 1997). In its most simplistic form, behavioural based safety involves the identification and listing of critical 'target' safe behaviours which are used by trained observers to measure compliance (Piscioneri, 1999). The reports ideally result in follow-up actions to increase safe behaviours, while decreasing or discouraging unsafe behaviours (Geller, 1996).

Behavioural based safety at a workplace attempts to bring about change in the attitudes and values of individuals by reinforcing and encouraging positive or desirable behaviours (Geller, 1996). The premise is that when certain behaviours become accepted and voluntary, they become a part of the workplace culture that influences attitude (Geller, 1996). Supporters argue that safety should be a norm and the way to achieve this is to reinforce safe behaviour through feedback. Additionally, behavioural based safety recognises that unsafe acts are not deterred naturally. Therefore there is a need to introduce means to reinforce safe behaviours.

Behavioural based safety is not an instrument that will immediately prevent incidents occurring in the workplace (Geller, 1996). Instead, it should be viewed as a vehicle that will lead to cultural change (Geller, 1996). It is this change in workplace culture (attitudes, norms and beliefs) that will lead to a decrease in incident occurrence. When implemented effectively, behavioural based safety can achieve its aim of reducing the number of unsafe acts which in turn will reduce the number of incidents (Geller, 1996).

There are a number of different behavioural safety management systems available. In the various systems, it is possible to recognise at least the following features:

1. Identification of critical behaviours which could contribute to, or have contributed to incidents;
2. A system of ongoing observations and feedback; and
3. Use of the data to identify corrective actions.

This study is not focussed on behavioural based safety as a process, but rather it employs some of the concepts and tools associated with behavioural based safety to measure compliance. This study aims to make use of the observational technique utilised in behavioural based safety management systems to record compliance with an employee developed checklist. In order to utilise behavioural observation as a data gathering technique, its validity must first be examined.

A number of studies have been undertaken to establish the success of such behavioural based safety checklists in the workplace. The first of these was in 1978, when Komaki attempted to determine whether feedback and reinforcement could reduce the presence of unsafe acts (Komaki, Barwick & Scott, 1978). Komaki reviewed the organisation's prior accidents and incidents to identify critical behaviours that caused a high proportion of accidents (Komaki et al., 1978). Two observers were then placed in the workplace to record the compliance with the identified behaviours (Komaki et al., 1978). When an employee exhibited an identified 'safe' behaviour, feedback was given to reinforce it (Komaki et al., 1978). Likewise, when an undesirable behaviour was identified, information was given to the individual to allow rectification (Komaki et al., 1978). The feedback was given on a weekly basis and an improvement was identified in performance (Komaki et al., 1978).

A later study to Komaki's (1978) study, found comparable results. Chhokar and Wallin (1984) conducted a study of the effect of behavioural observations and feedback on the safety performance of an industrial plant. They developed an assessment tool that targeted a number of specifically identified behaviours for the industry. Previous incidents were reviewed to establish critical behaviours that have contributed to incidents (Chhokar & Wallin, 1984). Further information was gained from accident prevention literature, trade information and literature from other companies (Chhokar & Wallin, 1984). The assessment tool was implemented and used over a two year period at the industrial workplace (Chhokar & Wallin, 1984). Not only was the effect on safety performance positive, it was also that the observation tool to be a valid measure of safety (Chhokar & Wallin, 1984). Interestingly, when both of the above studies concluded and the feedback system was removed, employee behaviour returned to the level prior to the research commencing (Chhoakr & Wallin, 1984; Komaki et al., 1978).

Krause, Seymour and Sloat (1998) conducted a meta-analysis to evaluate the effectiveness of behavioural based safety programs. The aim of this research was to determine whether behavioural based safety interventions were successful in reducing the incidents of workplace injuries and disease. Many of the behavioural safety management programs support the critical behaviours being developed by employees (Krause, 1997; Geller, 1996; Goodbourn, 1993). The rationale behind the employee-developed checklists is to increase ownership of the program and to utilise employee's working knowledge of hazards within the workplace. The review of behavioural based safety programs in 73 American companies also identified some critical success factors one of which was employee involvement in the process (Krause et al., 1998). While some may still argue with the results obtained from behavioural based safety, the focus on employee involvement in the process is seen as a critical factor in the success of any method of injury reduction.

As discussed the challenge faced by workplaces is the need to develop the means to combat natural reinforces. The realisation that unsafe acts may naturally be reinforced due to the low probability of an incident occurring has led many organisations to look at ways of supplementing the environment with artificial reinforcers for safe behaviour. This had led to the emergence of a number of approaches aimed at increasing the presence of safe behaviours. One of the most widespread methods of reinforcing safe behaviours is the growth of what has come to be known as workplace incentive schemes.

Workplace Incentive Schemes

Workplace Incentive schemes are a form of artificial reinforcement. The principle is to reward good performance in the belief that that will increase the likelihood of the performance being repeated. While incentive schemes are not a major focus of this research, the effect of such schemes on compliance scores will be measured to provide emphasis for further research into this area.

There has been an increase in the prevalence of what are known as incentive schemes (Goodbourn, 1993). Such schemes have been found to be moderately successful in numerous industries including manufacturing and construction in countries such as Finland and Israel, as well as the U.K. and U.S.A. (McAfee & Winn, 1989). However, research has found incongruous results in relation to the type of incentive schemes currently in place in many workplaces.

Goodburn (1993) is of the belief that there is some cultural explanation why American workers are so receptive to incentive schemes. However, it would appear that similar receptiveness is beginning to appear in Australia, with a dramatic increase in the number and variety of incentive schemes in workplaces. Incentive schemes that many Australians are familiar with include offering free airfares if people shop in certain stores or using certain credit cards. Similar incentive schemes have emerged in Australian workplaces. More recent, has been the emergence of such schemes in the area of health and safety. Safety incentive systems have become commonplace in many Australian industries and are commonly known as safety recognition systems or safety rewards schemes, yet they are all associated with reinforcement of identified behaviours.

Token Economies

Token economies have been used in many situations as an incentive to improve health and safety. This style of incentive scheme involves safe acts being rewarded with a token or similar item that can be accumulated to purchase goods (Kohn, 1993). Studies of the effect of token economies in the textile industry found slight increases in use of personal protective equipment (Zohar & Fussfeld, 1981; Zohar, 1980).

Fox, Hopkins & Anger (1987) examined the use of this system in two open cut coalmines. The resultant effect of the token economy system was a decrease in lost workdays and accident costs. However, results that report a reduction in accident rates should be treated with caution. Such measures fail to give a true indication of behaviour change, as they measure the outcome of a number of factors, only one of which is behaviour. Problems associated with the use of outcome measures have previously been discussed.

Pay for Performance

Money has often been used as a motivator for workers in many industries. Perhaps the most distinct use of pay for performance systems can be seen in the manufacturing industry (eg. piecework payment plans where a person is paid per piece or item). Occupational health and safety professionals have commented on the potentially negative occupational health and safety implications of piecework systems (Qunilan & Bohle, 1991). Effects such as injury reporting suppression, machine guard removal and work intensification have been reported in the literature (Goodbourne, 1993). All of these have negative impacts on the health and safety of employees.

Monetary incentives have been used to promote safe behaviours. Haynes, Pine and Fitch (1982) found a remarkable reduction in accident rates among urban transport operators, when extra money was offered as an incentive. However, this result may have been due to similar factors that are often raised against piecework pay schemes. Kohn (1993) argues that monetary incentives do not motivate workers, and a number of surveys have indicated that workers rank pay between fifth and tenth in terms of motivational and work satisfaction factors (Kohn, 1993; Greenberg & Greenberg, 1991; Kovach, 1987; Gruenberg, 1980).

Group Lottery

Some employers have implemented incentive schemes that result in the desired behaviour receiving a ticket in a raffle. The more desired behaviours which are exhibited, the greater the chance of winning. Such schemes fly in the face of the very theory that underlie them (Geller, 1996). In such a system, desired behaviours do not necessarily get rewarded because a lottery will only have a few winners. Therefore, people who do not win do not receive any reward for their behaviour or achievement. Only one individual is rewarded for their behaviour. This reward will occur sometime in the future (ie. when the raffle is drawn) and therefore the connection between the specific behaviour and the reward may not be made. For this reason such systems are rarely seen in industry today (Geller, 1996).

Material Reward

Material rewards in the form of coffee mugs, t-shirts or pens are becoming the predominant forms of incentives used in workplaces today (Martinkus, 1997). Many organisations use such items as a reward for working for a year without a lost time injury (Pardy, 1997). Goodbourn (1993) argues that such schemes are doomed to fail for numerous reasons. These include the reward (coffee mug or similar) may not be valued (ie. viewed as a positive reinforcer) by recipients and the reinforcer is too far removed from the behaviour it aims to reinforce (Goodbourn, 1993).

The latter form of incentive scheme best represents that which is present in one workplace in this study.

Employee Involvement

Employee involvement and ownership has been identified as an important factor in the success of many aspects of an organisation (Walton, 1985). Walton (1985) conducted a study of two workgroups that had differing degrees of involvement in the setting of the group's goals. It was found that the groups that were involved in the setting of their goals reported higher work satisfaction, better relationships with management and a reduced error rate (Walton, 1985). Interestingly, at the conclusion of the study, the group that was involved in setting their own goals achieved higher goals than the control group (Walton, 1985).

Many supporters maintain that any safety management system is doomed to fail if employees are not involved in the establishment of the program (Krause 1997; Geller, 1996). It is argued that while management has a critical role to play in the removal of barriers for safe performance and facilitating a smooth operation of the process, the ownership should be with the employees (Krause, 1997). It is argued that when employees implement the safety initiative, they possess the tools to train new participants and are personally invested in the improvement effort (Krause, 1997).

This collaborative approach to occupational health and safety replaces the traditional model of workplace improvement whereby supervisors are given the task of regulating the introduction of safety programs (Krause, 1997). Geller (1996) states that such a technique is not appropriate for behavioural safety interventions. Behavioural items that are unacceptable to the workforce are likely to be resented and ignored (Geller, 1996). Even, one or two items 'forced' unilaterally onto the list by management can colour employees' perceptions of the rest, regardless of their individual merits (Geller, 1996). Behavioural items should therefore be written by the workforce themselves - or at the very least, genuinely approved before being included in the final measure.

The benefits of employee involvement in checklist design is evident in the results from a recent study conducted on two construction sites in Finland. This study found that employee involvement in the development of safety assessment tools had a positive effect on safety at the sites (Laitinen & Ruohomaki, 1996). Furthermore, Laitinen and Ruohomaki (1996) found that standard safety checklists where ineffective when applied to the construction industry. This was believed to be due to nature of construction workplaces, being comprised of numerous workgroups and also an ever-changing environment (Laitinen & Ruohomaki, 1996). A standard checklist was not seen as an appropriate or effective tool that could be applied to the life of a project (Laitinen & Ruohomaki, 1996). Laitinen and Ruohomaki (1996) established a team at each workplace who were given the task of identifying what aspects of the workplace were critical to ensure a high degree of safety is maintained. The team, comprised of employees and management, established eight critical 'safety rules' (Laitinen & Ruohomaki, 1996). These included: use of personal protective equipment, keep walkways clear, return tools to their correct place and place electrical wires safely (Laitinen & Ruohomaki, 1996). A reward was given to the two sites that achieved their initial target after 26 weeks (Laitinen & Ruohomaki, 1996). No further reward was given during the 42- week study. Both workplaces recorded a substantial improvement in compliance with the 'safety rules' during the study period (Laitinen & Ruohomaki, 1996). Furthermore, compliance with the 'safety rules' remained high at the conclusion of the study indicating that the change was more due to ownership of the program than the presence of rewards (Laitinen & Ruohomaki, 1996). As the measure of the workgroup's motivation to improve the level of safety at the constructions site was high prior to the development of the 'safety rules', the researchers believed the process of involvement provided employees with a means to achieve this (Laitinen & Ruohomaki, 1996).

While preliminary evidence supports employee involvement, this has yet to be tested in an Australian workplace. This study aims to determine whether employee involvement in the development of a behavioural observation checklist results in a reliable and valid tool to measure organisational safety. If the findings confirm this, an argument can be established to supplement existing measures of safety performance. The benefits of such a measure to workplaces with be far reaching in terms of their ability to prevent injuries and illnesses from occurring.

Demographic Variables

Research has found that demographic variables such as age and experience have an impact on the presence of safe behaviour and occupational health and safety outcomes. In many cases the results obtained in workplaces can be replicated in the broader community (eg traffic accident studies). An overview of the recent research into the impact of age, experience and gender on unsafe beahviours has been presented.

Gender

Workers' compensation data show that in 1991-92 there were 38,609 cases of occupational injury or disease affecting women in Australia of which 29 resulted in a fatality (NOHSC, 1994). The overall incidence and frequency rate for women was 14 per 1,000 workers and 11 per 1,000,000 hours worked, respectively (NOHSC, 1994). While these rates were lower than those experienced by men (34 and 21), women experienced more severe occurrences in terms of time lost from work (NOHSC, 1994).

Saliminen, Saari, Saarela & Rasanen (1993), undertook a study to determine possible reasons for the differences between accident frequency rates for males and females. While this was a small study (N=100) of people who had been involved in serious workplace accidents, it did highlight some interesting trends. Firstly, the study identified that men were more likely to intentionally enter dangerous areas perhaps believing they had the skills and ability to control the situation (Saliminen et al., 1993). Secondly, women in the study were more critical of safety standards at the workplaces with greater than 50% believing safety was poorly organised (Saliminen et al., 1993). A similar American study found that workplace injuries are more common among men, with much of these being directly connected to what is defined as 'masculine' behaviour, risk-taking, aggression and the consumption of alcohol and other drugs (Standing 1997).

Age

Analysis of data in Australia has found a relationship between age and workplace fatalities (Alsop, Gafford, Langley, D'Begg, & Firth, 2000). Although fatalities may be rare workplace events, they represent the most comparable and reliable measure across all states of Australia. Other measures such as 'Lost Time Injures' (LTI) rely on workplace reports and workers' compensation data is recorded differently in each state jurisdiction. As a result LTI or workers' compensation claims cannot be accurately correlated with age. For this reasons workplace fatalities have been used to identify any relationship between age and compliance with safe work practices. Figure 8 represents the findings of an analysis of Australian workplace fatalities between 1989-92.

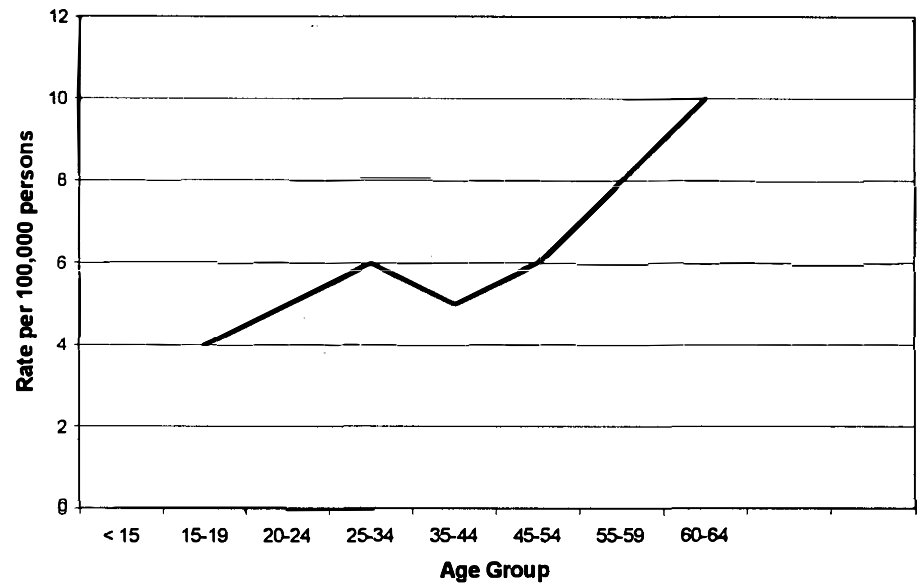


Figure 8 **Age of working person (working deaths rate) in Australia 1989-1992 (NOHSC, 1998).**

This analysis of Australian workplace fatalities found that certain age groups appear more likely to be killed at work. This diagram illustrates that 25-34 year olds have an increased risk of being killed at work. Furthermore, employees over 55 years old are significantly over represented in workplace fatalities when analysed by employment in full or part-time work (NOHSC, 1998). It could be argued that these statistics are misleading given that workplace fatalities are rare events in Australian workplaces, however, as described below, additional studies of workplace injuries have found similar results.

Young workers have been identified as a high-risk group by occupational health and safety bodies both throughout Australia and overseas. It has been reported that within Australia, young workers are more likely to be injured at work than older workers. Publications from South Australia and Victoria state that workers between the age of 17-24 are 75% more likely to suffer a workplace injury than older workers (South Australia Division of Labour, 1991, Victorian WorkCover Authority, 1996). Studies from the United States have found that the rate of injury per hour worked appears almost twice as high for children and adolescents as for adults - about 4.9 workers injured per 100 full-time-equivalent workers among adolescents, compared with 2.8 per 100 full-time-equivalent workers for all workers (National Research Council, 1998). Similar trends have been recorded in Canada, where 22% of workers' compensation claims are lodged by workers between the ages of 15 and 24 (Frangou, 1999).

A number of theories have been proposed by researchers to explain the high incident of workplace injuries amongst younger workers. The most probable of these theories is consistent with many risk based or motivational based models of motor vehicle driving (Deery, 1999). This theory relates to the concept known as risk perception. Risk perception is the level of risk, which a person is able to recognise and willing to accept (Stein & Allen, 1987). Stein and Allen (1987) believe that drivers determine the difficulty of their task by setting and accepting different risk thresholds. Deery (1999) supports this notion and adds that younger drivers are willing to accept a greater level of risk than older drivers. Interestingly, an earlier study that found younger drivers who purposively commit traffic violations, are cognisant of the fact that these behaviours are associated with higher risk (Stetzer & Hofmann, 1996). Stetzer and Hofmann (1996) also found that younger drivers compensated for safety features in vehicles (eg. seat belts, airbags, anti-lock braking systems) by increasing the prevalence of risky behaviours. It would appear that younger people prefer to operate at a higher risk threshold, believing they have the skills and experience to avoid hazards (Deery, 1999). Of great concern to safety professionals, is that it would appear younger persons may willingly disobey safety instructions to maintain their preferred risk threshold (Geller, 1996).

Young workers have been identified as a high risk group due to their values and beliefs, particularly in relation to risk. However, studies have showed some significant findings in relation to older workers and workplace injuries (Ringenbach & Jacobs, 1995). Ringenbach and Jacobs (1995) found in a study of over 200 nuclear power plant employees, that a direct relationship between age and injuries exists. This study also found that older employees were less likely to be injured at work, but they recorded more lost days due to workplace injuries (Ringenbach & Jacobs, 1995). In essence, older workers, once injured, take longer to recover. It can be argued from this study that younger employees have a higher degree of fitness than their older counterparts. This notion is consistent with past research and commonly held beliefs about physical strength and endurance (Schaie & Willis, 1991). While such differences in older and younger employees may be true, older employees were found to compensate for their reduced physical capacity by being more aware of safety in the workplace (Richenbach & Jacobs, 1995; Doering, Rhodes & Schuster, 1983).

It is therefore apparent from these studies that an employee's perception about risk varies with age. It would appear that younger workers have a higher level of acceptable risk than older workers. Possible explanations for this include the autonomy associated with part or full time work, and the level of maturity that work signifies (Gusfield, 1991). It is believed that these factors may contribute to an overestimation of the ability to deal with hazards when they arise (Gusfield, 1991). Conversely, as workers age, their physical fitness decreases, causing them to be more aware of safety. For the purposes of this study, age of participants is recorded and analysed against the presence of safe behaviours in each workplace to determine the extent to which the variables are related.

Expertise

Inexperience, as well as physical, cognitive, and emotional developmental characteristics, play a part in the risk of injury faced by workers (National Research Council, 1998). Research on adults shows that inexperience on the job contributes to occupational injuries (National Research Council, 1998). It should not be surprising then, if the inexperience of children and adolescents turns out to be an important factor in their work-related injury rates (National Research Council, 1998).

As with studies into age related factors, comparable information can be retrieved from road traffic studies. Deery (1999) found that novice drivers are over represented in Australian traffic accidents. While it is possible age related factors, as previously discussed, may confound these results, a number of researchers have discussed the distinction between age and experience (Deery, 1999; Elander, West & French, 1993). This difference is described as driving skill versus driving style (Elander et al., 1993). Driving skill, as with many skills, will improve with practice and training, while driving style is based on the decision-making aspects, such as hazard perception (Elander et al., 1993). Furthermore, driving skill is hypothesised to be related to inexperience, while driving style is hypothesised to be related to age. Therefore expertise relates more to the attainment of skill.

Research has found that injuries are more likely to occur when work requirements exceed the capabilities of the individual (Ringenbach & Jacobs, 1995). That is, a relationship between the level of competence or expertise of an individual and incident rates have been established. An analysis of 15 years of accident reports at a metal foundry identified that inexperienced workers are more likely to be injured (Dell & Berkhout, 1998). Dell and Berkhout (1998) found that new employees had an 18.5% chance of obtaining their first injury in the first month of employment. Of those uninjured employees who remained, 13% were injured in the second month and 10.4% in the third (Dell & Berkhout, 1998). This rate stabilised to 5% by the seventh month (Dell & Berkhout, 1998). It was hypothesised that new employees lacked certain skills to perform their job in a safe manner.

Traditionally, the manner in which organisations have managed inexperienced employees is to develop their skills through various forms of training. Training has previously been discussed as a factor in gaining an understanding of the process and practices at a new worksite. However, training is also an important factor in gaining expertise in a task. Task specific training, as opposed to awareness or induction training, can significantly improve safe performance of tasks (Ringenbach & Jacobs, 1995; CCH, 1998). The aim of task specific training is to ensure employees have the necessary skills to perform a task in a safe manner (Quinlan & Bohle, 1991). In cases where a task has been identified as high risk (eg. work with forklifts and cranes), the legislative authorities have required licences, hence enforcing a level of competence prior to allowing a person to undertake a task. A study conducted in a similar manufacturing environment to the workplaces participating in this study, found that in-house operator training is linked to lower accident rates (Smith, Cohen & Cohen, 1978). Recent studies in comparable industries (mining) found similar results (McDonald, Mc Dermott, Theunissen, & Crossley, 1996). McDonald et al. (1996) found that over a two-year period of in house task specific training, a reduction in lost time injuries and injury severity was observed in the study population.

Expertise has been identified as a factor that can impact on an individual's likelihood of being involved in a workplace incident. Inexperience, measured as length of time in current role, will be measured in this study to determine its effect on the outcomes observed. Length of time spent in current role has been used previously to measure this factor, as it incorporates new employees along with those who may have been at the workplace for some time, yet not in the current role (Dell & Berkhout, 1998). While this measure will not directly consider training undertaken by employees, it may do so indirectly. That is the time elapsed since an employee has recently moved into a new position may impact on their ability to attend training. While this link is present, it is at best tenuous, however the scope of the study does not allow for further investigation of training undertaken by participants.

Conclusion

Reason's Latent Failure Model of Incident Causation illustrates the complex relationship between a wide variety of factors in the incident causation sequence (Reason, 1991). The most visible control point in this sequence relates to how employees act at work. While this may be a result of upstream influences, it remains the item in direct control of people within the workplace. Being the factor immediately before an incident, the relationship between employee behaviour and incidents has been well documented. Evidence has been presented that suggests more than 85 percent of all aviation incidents can be traced to avoidable human error (Wiener, 1995; Johnson, 1998). Furthermore, a review of incident investigations and analysis techniques unearths frequent reference to human error or unsafe acts (System Safety Development Centre, 1995; Rothweiler, 1994; Harms-Ringdahl, 1993).

It has been recognised that a wide variety of workplace and personal factors impact on an individual's ability to work in a safe manner. These include age, experience, maintenance, workplace layout and design. All of the factors discussed have an impact on the presence of unsafe acts or unsafe conditions. The ability to affect change on these factors in the workplace is difficult. For example, the social norms and individual attitudes of inexperienced people are deep-rooted and moulded by the wider social environment (Bernstein et al., 1991). Therefore, the ability to directly modify them within a workplace is problematic. However, it is believed that by measuring compliance with identified safe behaviours, the establishment of workplace norms is possible (Krause, 1997) and is therefore possible to create or modify attitudes by modifying behaviour (Krause, 1997; Geller, 1996). This notion is based on the consistency theory discussed earlier, whereby an individual has an inherent need for their behaviour to correspond with their attitudes and beliefs. This principle indicates that workplace, and individual norms and beliefs, can be modified through behavioural intervention such as behavioural based safety.

The application of such behavioural based approaches to occupational health and safety were first researched in the late 1970's and since then have received increasing recognition as effective solutions to occupational health and safety challenges (Krause, Seymour & Sloat, 1999). During this time, a number of critical components have been identified which include: goal setting and positive feedback (Chhokar & Wallin, 1984), observation and positive feedback (Krause, 1997; Komaki). With these components, the need for employee involvement and ownership in the process has been identified as an important factor (Krause et al., 1999).

Although a number of studies have found that employee involvement in the establishment of the behavioural based safety program contributes to the success of the program, no research was located that isolated this factor as a critical component. The concept of employee involvement has been discussed in a number of studies, however the results have not been compared with a similar study where employees were not involved.

CHAPTER THREE

METHODOLOGY

Introduction

This chapter presents an overview of the methodology used to describe the impact of the use of an employee-developed checklist on behavioural compliance scores across two workplaces over a five month period. A comprehensive description of the research design, the selection and development of the instruments used to gather and analyse data has been provided. Additionally, details of the sample selected and the processes involved in the collection of data are also discussed.

Research design

The study was conducted in two distinct phases. The first phase was an instrument development phase while the second was an implementation phase. Phase I of the study involved the design of an employee developed checklist (EDC) and a theoretically developed checklist (TDC). Both tools underwent content validity testing through a panel of experts before being finalised. Phase II of the study involved the introduction of the EDC and TDC to Workplace B and Workplace C. Compliance with the components of the EDC and TDC was measured on a fortnightly basis. Results were analysed to determine any significant differences between checklists and workplaces. Figure 9 illustrates the two phases of the study.

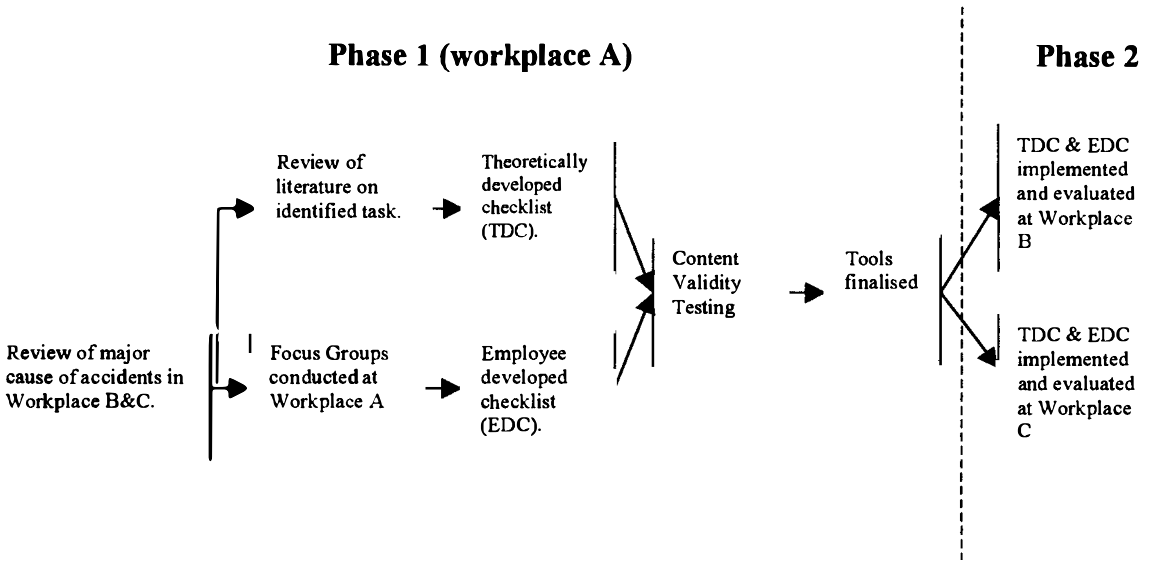


Figure 9 Study Design

The research was conducted within the Principles for Research on Human Subjects published by the National Health and Medical Research Council and endorsed by the Edith Cowan University Human Research Ethics Committee.

Sample and setting

The sample for this research was derived from three (3) large manufacturing and logistics companies based in Victoria. The companies were selected because they were considered representative of workplaces that have, or do not have an incentive program in place to promote safe work practices. Participants from one workplace were required to undertake Phase I of the study only. Volunteers were sought from employees and management staff at the other two workplaces for Phase II of the study.

Workplace A.

Workplace A is a national paper and cardboard manufacturer employing approximately 1250 people in three Victorian sites. The paper and cardboard manufactured at Worksite A is purchased by other organisations to develop a wide range of products. Worksite A does sell directly to the public, however the focus of the organisation is not in the sale of value added paper products. Workplace A has a well developed safety system and recently obtained a satisfactory rating following a audit by the Victorian WorkCover Authority. Occupational health and safety performance of Workplace A has been steadily improving over the past three years, with a significant reduction in the workers' compensation claims for the Victorian operations.

Workplace B.

Workplace B is one of a number of Victorian sites managed by a large Australian food manufacturer. Workplace B manufactures and distributes bread and cereal products under a number of well-known consumer brands. Approximately 700 people are employed at Workplace B working 6 days a week with a fixed 16 hour roster (2 x 8 hour shifts). Approximately half of the employees at Workplace B are from different ethnic backgrounds. Workplace B, being based in rural Victoria, is a significant employer in the town. The organisation has a well-developed safety system that has been in operation for over four years. The safety system places a large emphasis on safety sampling (i.e. behavioural observations) in which awards are given (incentive scheme). Employees at Workplace B are actively involved in the safety management at the site through a pro-active safety committee. The occupational health and safety performance at this site has improved, although not to the extent achieved by other parts of the business.

Workplace C.

Workplace C is one of a number of logistics sites in Victoria managed by a large Australian retailer. Workplace C stores and delivers grocery and variety merchandise to a large number of stores throughout Victoria. Workplace C operates 6 days a week, employing between 250 and 300 employees. Employees work a set roster of day, afternoon and night shifts. Most of the employees at Workplace C are employed on a full time basis, however casuals are used to meet demand during peak trading periods, such as Christmas. Workplace C is a relatively new site with a safety system equally in its infancy. Early impressions of Workplace C indicate that an 'us versus them' mentality currently exists with a largely unionised workforce. Workplace C has a safety performance that is considered by the organisation as less than adequate, prompting senior management to target an improvement in occupational health and safety performance.

Eligibility Criteria

Employees and management from Workplace A who regularly use or supervise the use of ride on lift trucks were invited to participate in Phase I of the study. These participants were involved in the design of the EDC and therefore it was crucial to restrict participation to those who could articulate the safe behaviours related to use of ride on lift trucks. Professionals who participated in the content validity testing for the checklists were approached by the researcher on the basis of their field of expertise.

Following the confirmation and validity testing of the checklists, subjects from Workplace B and Workplace C were invited to participate in the study. Participation in the study was open to all employees who regularly use ride on fork-lift trucks. Compliance scores of participants who were not observed on more than five occasions during the research period were excluded. This exclusion was to control for individual difference or aberrant performances.

Phase I

Phase I involved the development and testing of content validity of both the theoretically developed checklist (TDC) and the employee developed checklist (EDC). This phase was conducted with volunteers from Workplace A. Workplace A was not involved in Phase II of the study as a means of controlling for potential bias due to awareness of the study design. This allowed for objective testing of the EDC.

Phase I of the study aimed at developing an agreed list of observable, critical behaviours to be used as a checklist against which compliance to safe work practices could be measured. This checklist was standardised across Workplace B and Workplace C and remained for the duration of the study. The task chosen for assessment was the same for all three workplaces.

Instrument development.

The initial component of the development of the EDC involved a review of incident reports from Workplace B and C. The purpose of this review was to identify a high frequency task that had featured prominently in incident reports. Identifying such a task ensured that a sufficient number of observations would be recorded over the period of the study and secondly, that critical safety behaviours would be observed, hence providing relevant and meaningful feedback to the workplaces. The assessment of a high frequency task that had contributed to incidents also allowed for a comparison between behavioural compliance and incident rates to be undertaken.

Information on major incidents over the previous 12 months was requested from Workplace B and Workplace C. Major incidents were classified as incidents that resulted in one full shift away from work. This definition equates to Australian Standard definition of 'Lost Time Injuries' and hence is a known measure across industry. Lost Time Injuries (LTI) were chosen to provide an indication of severity. This was seen as important by the researcher to ensure a focus was placed on injuries that have an impact within the organisation. It was believed the results of the study would then provide useful information to the participating organisations.

While such criteria may have excluded minor incidents that had potential to be more serious, a means of limiting the number of reports was required. One hundred and ninety eight summarised records were received. Information was sought to identify causes and equipment involved in incidents. Both workplaces record incidents based on Australian Standard guidelines.

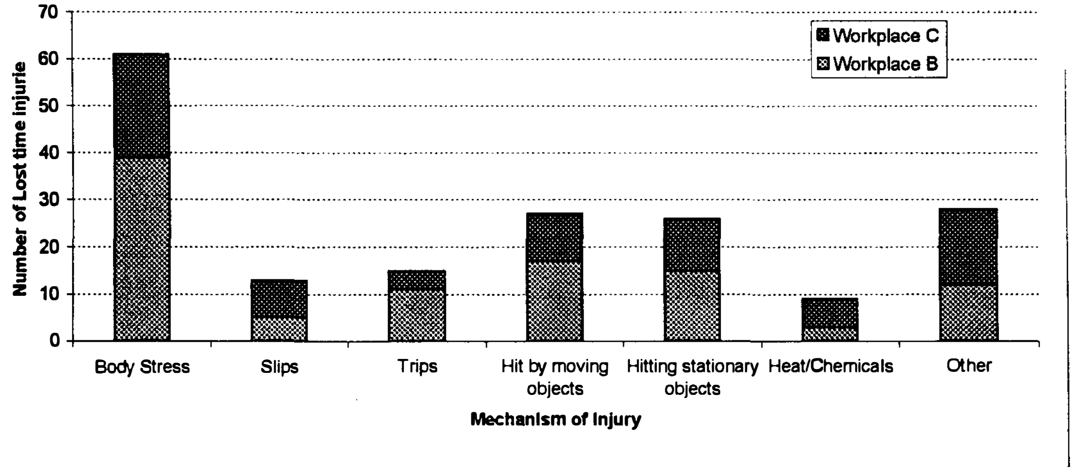


Figure 10 Mechanisms of Lost Time Injuries at Workplaces B&C (April 1998 – March 2000)

Figure 10 illustrates that body stressing (manual handling), being hit by moving objects and hitting stationary objects, are three main mechanisms that lead to types of

Lost Time Injuries. The diversity of manual handling tasks at both workplaces created difficulty in identifying a task for which specific behaviours could be observed within the scope of this study. While basic lifting principles are available from legislative authorities, the application of these principles depends greatly on the task involved. Furthermore the level of expertise required to evaluate the manner in which a person is undertaking manual handling tasks would require significant training. Therefore, observations of set criteria would not be possible for all tasks. For this reason, observation of tasks that may lead to body stress, although accounting for the greatest number of injuries at both sites was not used in the study.

Further analysis of the two other prominent mechanisms of injury (hit by moving objects, hitting stationary objects) was performed to identify common tasks or equipment related to these incidents. The results of this analysis are shown in Figure 11.

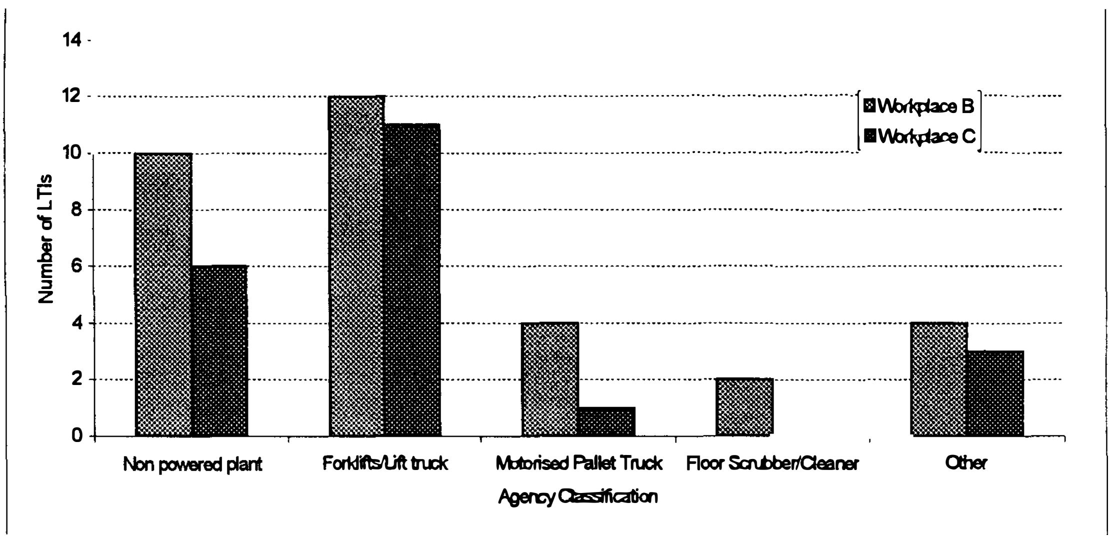


Figure 11 Analysis of agency of injury classifications of Lost Time Injuries at Workplaces B&C (April 1998 – March 2000)

Figure 11 indicates that powered mobile plant was involved in a majority of incidents coded as 'hit by moving objects' and 'hitting stationary objects'. Forklift and lift truck incidents were combined in Figure 11 as both pieces of equipment are similar in that they lift palletised goods, they are a ride on piece of equipment, they are powered and they both have tines (forks). Figure 12 presents both pieces of equipment for comparison.

Forklift **Lift truck**

Figure 12 Comparison of Forklifts and Ride on Lift Trucks

The chosen task to be observed throughout the study was 'using the ride on lift truck'. This was chosen due to the consistent application in all three workplaces. Site visits to Workplace A verified that the use of ride on lift trucks was a frequent task and high risk due to pedestrians and other mobile plant. Verification of this was performed to ensure that people involved in developing the EDC would have had knowledge of the task and equipment.

Recruitment procedure and ethical issues.

The researcher approached a colleague at Workplace A requesting assistance from the workforce in the design of the EDC. Following endorsement from management a notice was placed in the tearooms at Workplace A inviting all staff and management who regularly use or supervise the use of ride on lift trucks to assist in the development of the EDC. The notice gave details of a briefing session that was to be held at the workplace.

The briefing session was conducted to provide an overview of the study. No information regarding the study was withheld from employees at Workplace A. A written overview of the study and a consent form was provided to employees at this briefing session. A copy of the information and consent form used in this phase of the study is provided in Appendix I. Participants were asked to complete the consent form and place it in a locked box provided in the Occupational Health Centre at the workplace. The positioning of the box in this location provided security and a large degree of anonymity. A period of two weeks was given for participants to respond.

A second briefing session was conducted by the researcher to those employees of Workplace A who met the eligibility criteria and agreed to participate in the study. The purpose of this session was to provide further details on the process that would be followed in the development of the EDC and also to answer any questions the group had.

Development of Employee Developed Checklist (EDC).

Two focus groups, facilitated by the researcher, were conducted at Workplace A to develop a suite of behaviours that applied to operating a ride on lift truck safely. The intent of the list was not to incorporate all behaviour required to complete the task, but rather to focus on those behaviours that are viewed as critical to safe completion of the task. The list of behaviours would be compiled to form the employee-developed checklist. Chhokar and Wallin (1984) used a similar technique to establish a list of either five or six behaviours for a number of different tasks within a workplace.

Sixteen employees, familiar with ride on lift trucks took part in one of two focus groups. Brainstorming activities were conducted to identify components involved in the greater task. Participants were then asked to indicate which five were most critical from a safety perspective. Participants were asked to focus on easily observable tasks. A list of nine tasks was developed through this process. The same focus groups were re-established to condense the list to six observable behaviours. Figure 13 provides the final six critical behaviours identified by the focus groups at Workplace A.

EDC

Critical Behaviours for safe operation of ride on lift trucks

1. Both feet on platform (not hanging over edge)
2. Look prior to initiating movement
3. Slow down at end of each aisle
4. Ensure forks are down when moving
5. Sounding horn prior to entering new area
6. Ensure forks are tilted towards cabin when moving and raising

Figure 13 Checklist of critical behaviours developed by employees (EDC)

Once completed, the checklist was presented back to all participants at Workplace A for final endorsement. All participants agreed the checklist covered six behaviours critical to the safe operation of ride on lift trucks.

Development of Theoretically Developed Checklist (TDC).

It would have been preferable for the purpose of this study to validate the EDC by comparing it against the results of a previously validated checklist. Unfortunately no such checklist was available; therefore, a checklist based on available theoretical principles was required. The researcher, using available literature developed the theoretically developed checklist (TDC). While ideally, new tools should be validated against an established instrument, the lack of availability of a tool specific to the tasks undertaken at the study site prevented this. It was believed that a comparison with the TDC would provide an indication of consistency between the employee's perspective of critical behaviours and theoretical principles.

The TDC was developed from two main sources of literature related to ride on lift trucks, manufacturer guidelines and forklift training programmes (forklift licence training), information from forklift training programmes was considered essential because operation of this equipment requires licensing in all Australian jurisdictions. Guidelines from four manufacturers as well as occupational health and safety authorities in Western Australia, South Australia and Victoria, were also used to consolidate and verify requirements. This process resulted in the establishment of the ten-item inventory in Figure 14.

TDC

Critical Behaviours for safe operation of ride on lift trucks

1. Keep your hands on the controls at all times when the unit is moving
2. Travel with the forks close to the ground, retracted and tilted up.
3. Travel in the direction that gives you the best view
4. When travelling up or down slopes, ensure the load faces uphill.
5. Never lift loads with the mast tilted forward.
6. Ensure overhead clearance is sufficient before driving under structures.
7. Never drive the unit towards someone in front of a fixed object.
8. Maintain a distance of at least three truck lengths ahead.
9. Slow down when approaching intersections
10. Do not reach through the mast assembly.

Figure 14 Checklist of critical behaviours developed from available theory (TDC)

Content validity testing.

A panel of 5 experts was utilised to review the EDC for content validity. The size of the panel of experts is consistent with the recommendation of (Lynn, 1986) and included people with knowledge of OH&S (in particular forklift operation) and people with knowledge of instrument development. Participants with forklift operation included a certified forklift trainer, a representative from Crown (manufacturer), and a member of the Safety Institute of Australia. A member of the a major retailer's Research Department and a Senior Researcher from Queensland University of Technology was also involved to provide guidance from an instrument development perspective. Information relating to the background, aim and objectives of the study were supplied to participants prior to conducting the review. Due to logistical constraints, this information was provided to all panel members, via the telephone and electronic mail.

Participants on the panel were asked to review both the TDC and EDC and apply a relevance rating to the question. A four point scale was developed for this, ranging from 1= not relevant, 2 = somewhat relevant, 3 = quite relevant, and 4 = highly relevant. Participants who were present to analyse the TDC and EDC from an occupational health and safety perspective, were required to indicate how relevant compliance with the item was to safe operation of ride on lift trucks. Experts in instrument development were required to rate the relevance of each question based upon its structure, format and congruence with the research question.

Inter-rater agreement was then calculated to determine whether an item should be retained or excluded. An item was retained when inter-rater agreement was greater than 0.8 (80%). Once an acceptable level of agreement was reached, an overall index of Content Validity (CVI) was calculated (Lynn, 1986).

Phase II

Phase II of the study involved testing of the TDC and EDC at Workplace B and C. This testing of the EDC and TDC involved numerous observation sessions at both workplaces. Observation sessions were conducted across all shifts to account for any error due to perceived level of supervision. A total of 340 observations were made across both workplaces over a five-month period as shown in Table 2.1.

Table 2.1. Observation sessions at Workplace B and Workplace C

Observation session	Workplace B	Workplace C	Combined Workplaces
N observed on 6 occasions	12	9	21
N observed on 6 –9 occasions	7	10	17
N observed on >9 occasions	4	2	6
Total	**187**	**153**	**340**

The aim of Phase II of the study was to collect data that would allow for evaluation of the EDC and TDC as measures of compliance with safe work practices. Phase II of the study would also allow for analysis of relationships between compliance and workplace, age, gender and level of experience. Phase II involved a descriptive correlation analysis with two key components. The first component involved preliminary validation of the compliance scores from the EDC against scores from the TDC. The second component of Phase II involved the assessment of compliance at two sites, one with a safety incentive (Workplace B) scheme and one without (Workplace C). The reason for including a workplace with a safety incentive scheme was based on the need to evaluate the extent to which incentive schemes promote an increase in the presence of safe work practices. Hence, testing the instrument in both settings provides useful preliminary data to determine the feasibility of future larger scale studies.

At the conclusion of the study, each participant was invited to a group debriefing session. Sessions lasted between 10-30 minutes depending on questions asked of the researcher. The purpose of the session was to provide a brief description of the purpose of the study, what the findings were, and how participants assisted in the study. This de-briefing session was conducted to provide the participant with a learning experience as an outcome of participating in the research study. Participants were presented with a letter of thanks and the researcher's contact details. In addition to the session, participants received two relevant references relating to the project that the participant may wish to pursue along with the researcher's contact details should any further questions arise.

Recruitment procedure and ethical issues.

Participants were recruited for the study following attendance at relevant workgroup meetings. These meetings were conducted regularly at both Workplace B and Workplace C and were consistent with internal communication methods. At this forum information on the study design was provided, however the purpose of the study was not discussed in detail. It was felt that an in-depth discussion on the purpose, method and hypothesis of the study could have influenced the result. Study timeframes, participant expectations and confidentiality arrangements including data recording and storage were discussed at each workplace prior to calling for volunteers. A written overview of the project was provided to all employees at this meeting (Appendix II).

The written overview included the project title, a brief and clear description of the role(s) that participants play in the study, the length of time of participation in the study, and a statement that participants may withdraw at any time, for any reason, without any penalty whatsoever. Further assurances regarding confidentiality of data, which will be used for research purposes only; and a statement that participants will receive feedback at the conclusion of the study was re-iterated at this point. Participants were encouraged to review the written overview and if interested in participating in the study, to sign, date and return the form in the provided envelope to the Occupational Health and Safety Officer/Co-ordinator at the workplace.

Once participant numbers were finalised a briefing session was held at Workplace B and C. This session was conducted by the researcher to outline the parameters of the study. The general procedures of the study was re-iterated to all participants and they were informed that if a dangerous situation was observed, brief details of this will be given to the Occupational Health and Safety Officer/Co-ordinator in accordance with legislative requirements. Demographic data including age, period of employment and gender was collected at this point of the study to determine the characteristics of the study sample and to gain preliminary information about whether compliance scores are influenced by such factors.

Data collection.

On a fortnightly basis, observational sessions were conducted at random times throughout the operating hours of the business. Due to the varying shifts and high number of observation sessions, additional trained observers were utilised in both sites. The Occupational Health and Safety Officer from Workplace B and one of the Health and Safety Training Officers from Workplace C were recruited and trained as observers to assist in the data collection. The use of trained observers in data collection, also provided a means of reducing bias due to the Hawthorne effect. As behaviour was being observed, it was possible that the presence of the researcher (ie someone external to the company) may cause employees to perform the task differently (Geller, 1996). The presence of internal, less conspicuous observers would have assisted in minimising this effect.

Training provided to observers consisted of the following: (a) a review of the list of specified behaviours, (b) viewing a video of safe and unsafe acts, (c) making observations accompanied by an experienced observer, and (d) a comparison of results between trainee and experienced observer (Chhokar & Wallin, 1984). The video used in this training is owned by the researcher and depicts similar tasks to those undertaken at Workplace B and Workplace C. The researcher and a trained observer in each workplace performed joint observations on a monthly basis to allow assessment of inter-rater reliability.

The TDC and EDC were compiled into one checklist to assist in the simple recording of observations. The resultant 16-item checklist was used during observation sessions. This process allows for comparison of results at the conclusion of the study while maintaining a manageable recording system. At the conclusion of the study, the observation tool had been successfully completed on 312 occasions at both workplaces.

Data analysis for phase II.

Data was analysed using SPSS (Version 9) using a 0.5 level of significance. Descriptive statistical analyses were undertaken to provide a summary of the characteristics of participants at workplace B & C. Descriptive statistics obtained included gender, age and the number of full years experience in using the piece of equipment. The demographics not only provided a summary of the participants, but were also analysed to determine any effect on compliance and identify any difference between workplaces. The specific analyses used for each research question will be described in the relevant sections below.

Research questions 1 – Does an employee developed checklist provide a valid and reliable measure of safe work practice compliance when compared with a theoretically developed checklist?

To address research question 1, the EDC and TDC underwent a process of content validity testing. The relevance rating given by each member of the panel for each item on the checklist allowed an Index of Content Validity to be calculated. This index is an indication of the level of agreement between members of the panel (Lynn, 1986). A high degree of agreement would indicate that the EDC and TDC are both measuring the critical behaviours for the safe operation of ride on lift trucks.

Further analysis involved calculating the mean compliance scores using the EDC and TDC. Mean compliance was used to account for the differing number of observations sessions undertaken by participants. The scores for the EDC at site B and C were combined and compared with the scores for the TDC at site B and C (Figure 15).

Employee developed checklist (EDC)	**Theoretically developed checklist (TDC)**
Mean compliance score of site B and C	Mean compliance score of site B and C

Figure 15 EDC and TDC validity testing design

Four statistical analyses were conducted to establish the construct validity of the EDC. Non parametric tests were used because the scores were not normally distributed. Firstly a Wilcoxon signed-ranks test was used to determine whether there was any significant difference between the compliance scores measured by the EDC and TDC. Secondly, a correlation using Spearman's rho was conducted to determine the relationship between the scores obtained on the EDC and TDC. Thirdly, the total mean compliance scores of each of three items from the EDC and corresponding items on the TDC that appeared to be assessing the same behaviour were compared. The panel of experts identified these three behaviours from each checklist. It was believed that the behavioural description was similar enough, albeit expressed slightly differently. A Wilcoxon signed-ranks test and correlation was conducted to determine whether there was any significant difference between the mean scores for these items.

A further analysis of validity was undertaken by comparing mean compliance scores against incident rates associated with ride on lift trucks for the two workplaces. As the checklists are measured compliance with safe ride on lift truck behaviours, mean compliance was compared against ride on lift truck accident occurrence each fortnight.

Inter–rater reliability was determined by comparing the scores recorded during joint observations (observations undertaken simultaneously by the researcher and an assistant from the workplace). A total of 22 joint observations were undertaken on a monthly basis and the resultant compliance scores analysed using the intraclass correlation coefficient and by determining the percentage agreement.

Research question 2 - To what extent does the employee developed tool detect differences in compliance with safe work behaviours in settings with and without safety incentive schemes?

To determine whether the incentive scheme in place at Workplace B had any effect on compliance score, the total mean scores for Workplace B were compared with Workplace C using the Mann-Whitney test. Table 2.2 illustrates this design.

Table 2.2. Comparison of compliance scores between workplaces

Workplace B		Workplace C
Total compliance score for EDC	vs	Total compliance score for EDC
Total compliance score for TDC	vs	Total compliance score for TDC

Research question 3 - What are the relationships between the variables of age, gender and employment tenure in relation to safety compliance scores?

The relationship between mean compliance scores and age and experience were analysed using Spearman's rho. The effect of gender on mean compliance scores was measured using the Mann-Whitney U test.

CHAPTER FOUR

RESULTS

Introduction

The objective of this study was to develop and test an instrument for assessing employees' compliance with safe work practices. Development of the instrument was achieved through focus groups at a workplace familiar with the task under observation and has been described in chapter two. Testing of the instrument involved a variety of methods that measured the reliability and validity of the tool, as well as its application in the field of occupational health and safety. Compliance scores were not normally distributed at either workplace and as a result non-parametric tests have been used throughout the study.

Participants

In Phase I, a total of sixteen employees from Workplace A satisfied the eligibility criteria and agreed to assist in the instrument design process. All sixteen participants were male and possessed in excess of two years experience supervising or operating ride on lift trucks. A panel of five experts in the fields of occupational health and safety, forklift operation and instrument development were engaged to review the EDC and TDC prior to implementation.

A total of fifty (50) employees who satisfied the eligibility criteria volunteered to participate in Phase II of the study. Thirty-six employees who met the eligibility criteria for entry declined to participate in the study. A further six (6) participants were not observed on more than five (5) occasions and therefore their results were excluded from the study. Table 2.3 illustrates the number of participants from each workplace along with the combined total.

Table 2.3. Recruitment and Retention of Participants - Phase II

Participants	Workplace B	Workplace C	Combined Workplaces
Declined to participate	10	13	36
At commencement of study	27	23	50
At conclusion of study	23	21	44
Males	20	18	38
Females	3	3	6

Demographic information for participants in Phase II

Demographic data including age, experience driving ride on lift trucks and gender was collected at the beginning of the study to determine the characteristics of the study sample and to gain preliminary information about whether compliance scores are influenced by such factors. Table 2.4 shows the demographic data for the participants at Workplace B and Workplace C along with the total study population.

Analysis of this data identified that there was no significant difference between the ages of participants at the two workplaces ($Z= 1.32$; $p = .24$). Likewise analysis revealed that there was no significant difference in the experience level of participants between Workplace B and Workplace C ($Z = 0.86$; $p = .35$). As expected, a significant and positive relationship was found between age and level of experience ($r_s = .56$). However no such relationship was found between gender and age ($Z = 1.24$; $p = .62$) or experience ($Z = 1.01$; $p = .12$).

Table 2.4. Demographic information of study participants

	Frequency (%)		
	Workplace B	Workplace C	All subjects
Gender			
Males	20 (87%)	18 (86%)	38 (86%)
Females	3 (13%)	3 (14%)	6 (14%)
Experience			
<=1 year	8 (35%)	4 (19%)	12 (27%)
2-5 years	11 (48%)	10 (48%)	21 (48%)
6-10 years	1 (4%)	5 (24%)	6 (14%)
>10 years	3 (13%)	2 (9%)	5 (11%)
Total	**Mean: 4.04** **S.D.: 5.32**	**mean: 4.95** **S.D.: 3.59**	**mean: 4.48** **S.D.: 4.55**
Age			
<=25	6 (26%)	4 (19%)	10 (23%)
26-35	9 (39%)	10 (48%)	19 (43%)
36-45	5 (22%)	4 (19%)	9 (20%)
>45	3 (13%)	3 (14%)	6 (14%)
Total	**Mean: 32.83** **S.D.: 9.52**	**mean: 33.05** **S.D.: 9.06**	**mean: 32.93** **S.D.: 9.20**

Validity and Reliability of the EDC compared with the TDC

The EDC underwent a number of analysis to determine the reliability and to provide preliminary evidence of validity of the checklist. Due to the lack of availability of previously validated checklists, the results obtained in this study provide preliminary evidence of validity only. The content validity of the EDC was assessed initially.

Following this, the EDC was assessed in the field to determine the external validity and reliability.

Demonstration of EDC clarity and content validity

To date, there is no previously tested checklist available to observe behaviours relating to the safe operation of ride on lift trucks. Therefore new checklists needed to be developed. A panel of five (5) experts was formed to review the EDC and TDC for content and face validity. Participants on the panel were asked to review both the TDC and EDC and apply relevance ratings to the item. A four point Likert-type scale was developed where: 1= not relevant, 2= somewhat relevant, 3= quite relevant and 4= highly relevant. The results from participants of the panel provided information to calculate an Index of Content Validity (CVI). The CVI was calculated by establishing the number of participants on the panel who rated the item as relevant (scoring of 2,3,4) divided by the number of participants who rated that item. The CVI calculation is below:

$$\text{CVI} = \frac{\text{No. of items ranked 2,3,4}}{\text{No. of participants who rated item}}$$

The CVI for items on each checklist and the overall CVI for the EDC and TDC are shown in Table 3.1. Some items on both checklists obtained high agreement from all participants on the panel, while the deviation from the mean score on other items was greater. This finding may be due to the different experience and areas of expertise of panel participants. Nevertheless, the results in Table 3.1 indicate that all panel participants rated items on both checklists as relevant.

Table 3.1. Panellist rating of EDC and TDC compliance statements.

	Panellist					
	1	2	3	4	5	CVI
EDC						
1. Both feet on platform	4	3	4	4	4	1.0
2. Look prior to initiating movement	3	4	4	3	4	1.0
3. Slow down at end of each aisle	3	4	3	3	4	1.0
4. Ensure forks are down when moving	4	4	4	4	4	1.0
5. Sounding horn prior to entering new area	2	3	3	3	3	1.0
6. Ensure forks are tilted towards cabin when moving and raising	3	3	3	4	3	1.0
Total CVI for EDC						**1.0**
TDC						
7. Keep your hands on the controls at all times when the unit is moving	4	4	3	4	3	1.0
8. Travel with the forks close to the ground, retracted and tilted up.	4	4	4	4	4	1.0
9. Travel in the direction that gives you the best view	3	2	2	2	2	1.0
10. When travelling up or down slopes, ensure the load faces uphill.	4	3	4	4	4	1.0
11. Never lift loads with the mast tilted forward.	3	3	3	4	3	1.0
12. Ensure overhead clearance is sufficient before driving under structures.	3	2	2	3	4	1.0
13. Never drive the unit towards someone in front of a fixed object.	3	4	4	4	4	1.0
14. Maintain a distance of at least three truck lengths ahead.	4	4	3	3	4	1.0
15. Slow down when approaching intersections	3	4	3	3	4	1.0
16. Do not reach through the mast assembly.	4	4	4	4	4	1.0
Total CVI for TDC						**1.0**

1= not relevant, 2 = somewhat relevant, 3 = quite relevant, and 4 = highly relevant.

Validity of EDC as compared to TDC

This study aimed to identify whether employees could develop a valid tool to measure compliance with safe behaviour at a workplace. As discussed a previously tested standard checklist against which to measure the EDC was not available, therefore a standard checklist was develop through consulting operating manuals and various related literature. Preliminary testing for the validity of the EDC was conducted in a number of ways. Firstly, the validity of the EDC was analysed by comparison of the total compliance scores for the EDC and the TDC. Total compliance scores were expressed as a percentage for each tool. Then the combined scores for the EDC at workplace B and C were compared with the combined scores for the TDC at both workplaces as shown in Table 3.2.

Table 3.2. Comparison of EDC and TDC

	EDC	TDC
N	44	44
Mean (compliance score %)	82.60	83.40
Standard deviation	10.08	7.58
Median	83.33	84.50
Wilcoxon signed-ranks test	$Z = 0.11$, $p = .91$	

The Wilcoxon signed-ranks test for dependent samples indicates that there was no significant difference between the compliance scores recorded on the EDC and the scores recorded on the TDC. The Wilcoxon signed-rank test was used because the same task was concurrently rated using each checklist. Analysis of the correlation between the scores obtained on the TDC and EDC revealed a strong positive relationship between the two checklists ($r_s = 0.414$ $p = .32$).

A further analysis to test for preliminary evidence of validity was obtained through the comparison of compliance scores for similar items on the EDC and TDC. Items assessed as being similar, albeit expressed differently on the EDC and TDC were identified by the researcher and also through the panel of experts. Three questions on the EDC and TDC were believed to be similar enough to warrant further investigation.

Table 3.3, 3.4 and 3.5 compare the results of these items. A Wilcoxon signed-rank test and correlation using Spearman's rho was conducted for each of the common statements because the compliance scores were obtained from common observations sessions. Therefore, the compliance scores on the EDC and TDC are related variables.

The results of the Wilcoxon test and spearman's rho correlation analysis in Table 3.3 indicate that item 3 on the EDC (*'Slow down at end of each aisle'*) and item 9 on the TDC (*'Slow down when approaching intersections'*) were scored almost identically. Likewise, item 6 on the EDC (*'Ensure forks are tilted towards cabin when moving and raising'*) and item 5 on the TDC (*'Never lift loads with the mast tilted forward.'*) recorded similar compliance scores, as shown in Table 3.4. The results obtained when the analysis was applied to item 4 of the EDC (*'Ensure forks are down when moving'*) and item 2 of the TDC (*'Travel with the forks close to the ground, retracted and tilted up'*) once again shows no significant difference in the scores (refer Table 3.5).

This preliminary testing for validity provides further evidence to support the hypothesis that that the EDC is a valid tool when compared with the TDC. As previously stated this result represents preliminary testing of the validity of the EDC only.

Table 3.3. Comparison of mean scores from EDC 3 and TDC 9

	EDC 3	TDC 9	
N	44	44	
Mean	5.84	5.93	
Standard Deviation	1.77	1.81	
Min	3	3	
Max	11	11	
Median	5	5.5	
Wilcoxon signed rank test			$Z = 0.05$, $p = .95$
Spearman's rho			$r_s = 0.966$

Table 3.4. Comparison of mean scores from EDC 4 and TDC 2

	EDC 4	TDC 2	
N	44	44	
Mean	6.05	5.86	
Standard Deviation	1.58	1.65	
Min	3	4	
Max	11	11	
Median	5.5	5	
Wilcoxon signed rank test			Z = 0.04, p = .10
Spearman's rho			$r_s = 0.575$

Table 3.5. Comparison of mean scores from EDC 6 and TDC 5

	EDC 6	TDC 5	
N	44	44	
Mean	6.05	6.07	
Standard Deviation	1.29	1.72	
Min	3	3	
Max	9	11	
Median	6	6	
Wilcoxon signed rank test			Z = 0.08, p = .93
Spearman's rho			$r_s = 0.430$

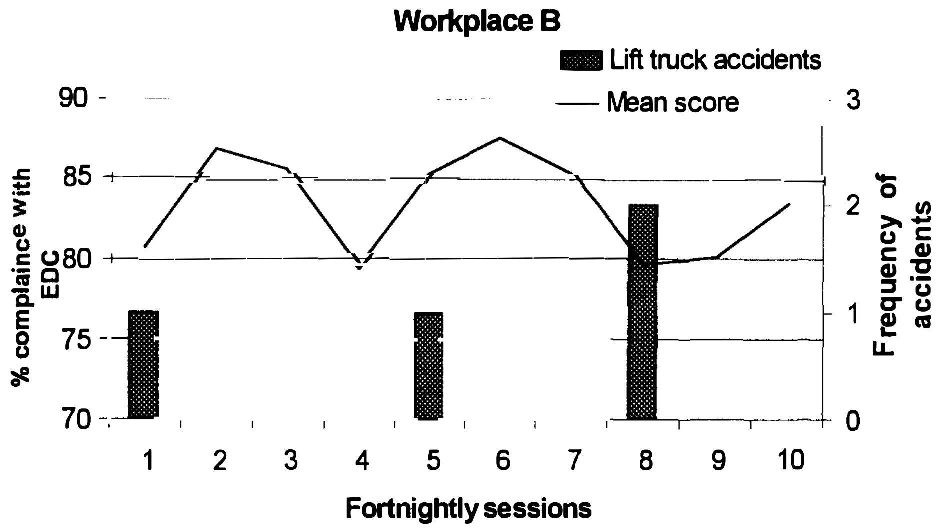
The final measure of validity of the tool involved analysis to determine whether the tool could be used to predict accidents. While this was not the focus of this study, it was believed that an organisation's perception of the value of the EDC would be dependent upon the EDC's ability to measure safety and to identify opportunities for improvement.

To achieve this, the results of the EDC were compared with traditional measures of safety performance.

To establish the relationship between the compliance scores and accidents, fortnightly compliance scores were graphed against accident occurrences associated with ride on lift trucks for the two workplaces. The aim of this comparison was to identify any relationship between compliance score and accidents. The results are illustrated in Figure 16.

Visual analysis indicates conflicting evidence of a relationship between mean compliance scores and the occurrence of accidents. The accidents at Workplace B during the course of the study, occurred within a fortnight of the mean compliance score dropping below 80%. At Workplace C, three accidents occurred when compliance scores dropped below 80%, but 2 occurred when compliance was scored at greater than 80%. Therefore no consistent trend could be established between compliance scores and accident occurrence.

The relationship is confounded by a number of factors including the rare nature of workplace incidents and the proportion of ride on lift truck accidents to other accidents in the workplace. The comparison of ride on lift truck accidents between the two workplaces is a crude measure as a number of confounding variables are present in this analysis. The differences in the number of ride on lift trucks and the hours of operation of the workplaces are just two of these confounding variables. This relationship requires further analysis before any conclusions can be made.



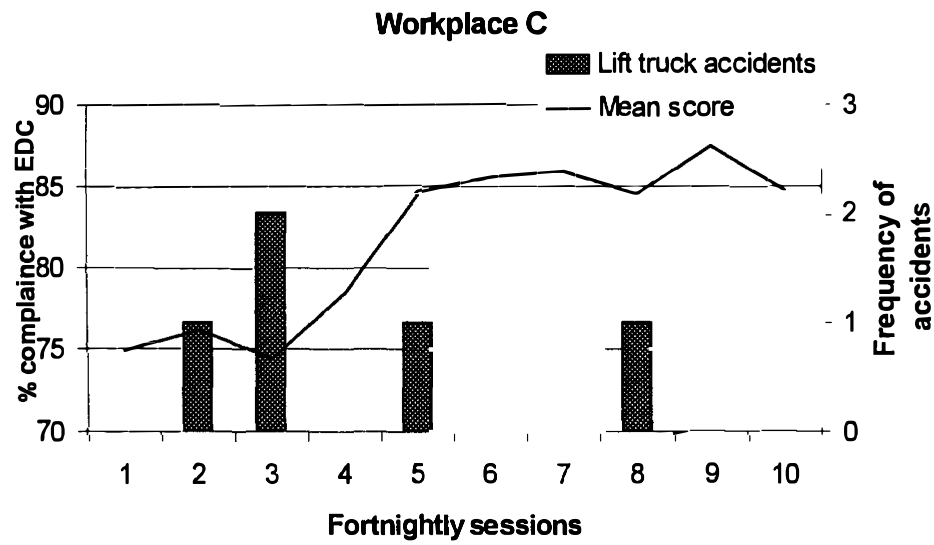


Figure 16 Mean compliance scores and ride on forklift occurrences during the study.

Reliability of the EDC & TDC

To establish the reliability of the checklist joint observations were conducted at regular intervals throughout the study. At the conclusion of the study, twenty-two joint observations (12 at Workplace B, 10 at Workplace C) had been undertaken during the study to obtain data on the reliability of the checklists. The joint observations involved two observers recording compliance on the same task. Information from these observation sessions has been used to determine the inter-rater reliability using the intraclass correlation coefficient (ICC), which examines the variance between scores recorded by the observers. The raw data shown in Table 3.6 and Table 3.7 indicates a high agreement between the raters.

Table 3.6. Compliance scores for joint observations at Workplace B

Researcher		Observer	
EDC	TDC	EDC	TDC
6	9	6	9
5	9	5	10
4	9	5	10
6	9	5	9
6	10	5	10
6	10	5	9
5	10	4	9
5	9	4	9
5	9	6	10
6	9	5	10
5	10	6	9
5	10	6	9

Table 3.7. Compliance scores for joint observations at Workplace C

Researcher		Observer	
EDC	TDC	EDC	TDC
5	9	6	8
6	9	6	9
5	10	6	9
4	10	5	10
4	9	6	10
5	9	4	9
6	9	5	10
6	10	5	10
6	10	6	9
6	10	6	9

Four intra class correlation analyses were conducted with results indicated in Table 3.6 and 3.7. The percentage agreement between the observers in each workplace is also indicated. While the ICC and percentage agreement suggests poor reliability, if the criteria for agreement was relaxed to allow a maximum of 1 point difference, the percentage agreement would have been 100% for both checklists at each workplace.

Table 3.8. Intra class correlations and agreement from EDC and TDC

Checklist	ICC	% agreement
EDC		
Workplace B	-0.0545	30%
Workplace C	-0.0667	50%
TDC		
Workplace B	-0.0370	40%
Workplace C	-0.0370	30%

Impact of Incentive Schemes on compliance

To measure any difference in compliance between Workplace B (safety incentive scheme in place) and Workplace C mean compliance scores were compared using a Mann Whitney test. The results of this test are shown in Table 3.5.

Table 3.9. Comparison of compliance scores between workplaces

	N	EDC Compliance score	TDC Compliance score
Workplace B (incentives in place)	23	Mean = 83.4 S.D. = 11.4	Mean = 82.2 S.D. = 8.8
Workplace C (no incentives)	21	Mean = 81.7 S.D. = 8.6	Mean = 84.7 S.D. = 6.0
Mann Whitney		Z = 1.05 p = .30	Z = 0.90 p = .37

Using the EDC, workplace C has a slightly lower mean compliance score than Workplace B, but this trend is reversed when using the TDC. These differences, while present are not statistically significant. Thus this study was unable to detect any positive effect of incentives on compliance scores. An outcome of this pilot study is the contribution the data will make for future studies on the effect of incentive schemes. An important aspect of this is to determine the required sample size that would be required to obtain statistically significant differences between two workplaces. Power analysis indicates that a total sample size of 1393 participants would be required to detect a statistically significant difference (0.5) in compliance scores between the two workplaces, with a power of 80%.

Impact of Demographic Variables on compliance

An analysis of demographic data was undertaken to determine the association between demographic factors and compliance of both the EDC and TDC. As there was no significant difference in the scores obtained in workplace B and Workplace C the analysis of demographic variables was conducted on the study population as a whole, rather than as two separate workplaces.

Age of the participants was analysed against their mean compliance score at the conclusion of the study using Spearman's rho. No significant relationship between age and mean compliance score was identified in this study ($r_s = 0.17$ $p = .66$). A similar analysis was conducted to determine the relationship between experience and mean compliance score. This study identified a small, positive relationship between experience and mean compliance score ($r_s = 0.32$, $p=.048$). There was also a small positive correlation between age and experience ($r_s = 0.41$, $p=.51$). However, this correlations was not significant. A Mann-Whitney test was used to determine the relationship between gender and mean compliance score in this study. No significant relationship was found between gender and mean compliance score ($Z= 2.31$; $p = .13$). This may be due to the small number of females involved in the study (N=6)

The analysis of the EDC supports the hypothesis that employees are able to develop a valid tool to measure compliance with safety requirements of workplace tasks. However the analysis did not support the hypothesis that the measurement tool was reliable. Possible reasons for this will be presented in the discussion section. The challenge that workplaces continue to face is the acceptance of checklists similar to that developed in this study. Any such checklist must be able to provide meaningful results to a workplace. In this study, the checklist failed to predict workplace accidents, which must be overcome to assist in the acceptance in workplaces. The implication and benefits of this will be further discussed.

CHAPTER FIVE

DISCUSSION

Introduction

This study aimed to develop and test an observational checklist to measure safe practices for ride on lift truck operations by employees. Employees were involved in the development a checklist of behaviours that are crucial to the safe operation of ride on lift trucks. This study aimed to establish the internal and external validity and reliability of the checklists by having both checklists reviewed by a panel of experts, testing the checklists in two independent workplaces and undertaking joint observations with a trained observers.

Furthermore, an assessment of the compliance level at each workplace was undertaken to determine the impact that incentive schemes have on compliance scores. Finally an analysis of demographic variables was undertaken to describe the sample and to provide data to assist in the design of future studies on this topic. Each of these components will be discussed further along with the limitations identified in this study.

Employee Involvement in developing the checklist

In the past, two sources of knowledge have been used to create intervention programs in the field of occupational health and safety, expert knowledge and shop floor knowledge of the workers exposed to the hazards (Sundstrom-Frisk, 1999). Some theorists maintain that any safety management system is doomed to fail if employees are not involved in the establishment of the program (Krause 1997; Geller, 1996). The benefits that this joint approach provides are more than simply realistic prevention programs, but also a greater degree of risk awareness (Sundstrom-Frisk, 1999). Sunstrom-Frisk (1999) argues that involvement increases acceptance as humans are more inclined to accept decisions that they have been involved in. It is further argued that employee involvement facilitates the acquisition of skills and resources to train new participants and develop personal investment in the improvement effort among employees (Krause, 1997). Therefore participation may be in itself, an important prevention strategy.

The potential value and feasibility of employee involvement was analysed through the comparison of the EDC and TDC. Should the EDC and TDC be found to yield similar results in the field, it would support the hypothesis that employees have the ability to develop a checklist comparable with one developed from theory. The results of this study indicate that employees do possess the skill and knowledge to develop an observational checklist that achieved statistically comparable results when validated against a checklist developed from theory. This study shows that although employees may articulate the requirements differently, they are able to identify the key behaviours required to complete a task safely.

Results for the inter-rater reliability of the EDC were below the acceptable level of 0.8. However the fact that joint observers recorded scores within a point of each other throughout the study offers some prospect of future positive results in respect of reliability of the EDC. As the inter-rater relaibility test measures the variance in scores to the total variance, it has shortcomings when applied to a homogenous sample (Deyo et. al, 1991). The compliance scores obtained from the study population were generally high suggesting the sample workplaces were overall very compliant. The small degree of total variation in the sample may have exaggerated the variation between observers. Nevertheless, as neither the EDC nor the TDC had acceptable reliability scores, further research is warranted to improve the reliability of observational tools, or the way in which they are used for assessment of safe behaviour in the workplace.

The results of a review of the EDC by a panel of experts provides evidence of internal validity, indicating that employees are able to develop an internally valid tool to measure the presence of identified safe behaviours for workplace tasks. The panel found that all of the items were relevant to the safe operation of ride on lift trucks. Employee's ability to define these items with such accuracy and relevance may be explained by the legislative requirement for licensing of all ride on lift truck operators. As the eligibility criteria for the study required the participant to hold a license, which includes a competency test, all participants had knowledge of the critical safe behaviours. The more crucial test of the EDC involved determining whether it was valid and reliable when used in a workplace setting. The absence of statistically significant differences between the mean scores obtained on the EDC and TDC, along with a similar lack of statistically significant difference between mean scores obtained for three questions from each checklist provide preliminary evidence of the employee's ability to develop a valid observational checklist. These results suggest that employees are able to develop a checklist that is comparable to one developed by an occupational health and safety professional.

This study was not conducted to test the effect of employee involvement. Rather, the study was primarily interested the employee's ability to develop a valid and reliable tool. To undertake this the checklist was developed at a separate workplace to remove any bias that may have occurred if the tool was developed in-house. Knowing that this works, future study in this area could involve employees in both the development and testing at the same site. This could be done by comparing results from a site involved in developing the checklist with a site that wasn't. Previous studies suggest that this would provide greater variation in scores (Sunstrom-Frisk,1999).

This study found that employees are adequately skilled to identify and articulate behaviours that are critical for the completion of the same task. MacIntosh and Gough (1998) recently reviewed the performance of four large Australian manufacturing companies. They found that more innovative approaches to occupational health and safety (ie those beyond mere legislative compliance and with greater emphasis on employee involvement) produced positive occupational health and safety performance (MacIntosh & Gough, 1998). The common component among the better performers in this study, was their ability to empower and involve employees in decisions affecting them (MacIntosh & Gough, 1998). The results of these previous studies are particularly relevant to this study, as they refer to the same or similar industries. There is evidence to support that employee involvement and ownership can lead to improvement in performance (Walton 1985; Krause, 1997; Geller, 1996).

Many organisations have in the past employed consultants to develop programs, while there exists a great depth of knowledge within their own workforce. Geller (1996) found that safety initiatives that are unacceptable to the workforce are likely to be resented and ignored. Even one or two small issues forced unilaterally onto employees by management, can colour employees' perceptions to the rest of the program (Geller, 1996). The results of this study further endorse the fact that employees should be involved early in the development of health and safety programs as well as any such program being approved by workers before implementation. It has previously been found that groups involved in the setting of their goals report higher work satisfaction, better relationships with management and a reduced error rate (Walton, 1985). Furthermore, while management have a critical role to play in the removal of barriers to safe performance and facilitating the smooth operation of the process, the ownership should be with the employees (Krause, 1997). Where employees implement the safety initiative, they possess the tools to train new participants and are personally invested in the improvement effort.

Organisations attempting to replicate the process followed in this study will potentially reap a number of rewards. Not only will they find themselves using a proactive measure of their health and safety performance, the benefits of which have been discussed earlier, but this measure is also inexpensive and flexible. The study provides preliminary evidence of employee's ability to develop a valid checklist, indicating the presence of a bank of knowledge that can be utilised by the organisation. As mentioned, the use of internal resources is an inexpensive option for employers. The simple model of employee involvement applied in this study also provides for flexibility. The use of checklists to measure compliance allows the organisation to focus on tasks that are high risk at any given point in time. In this way, the organisation can modify the measure to suit the need or focus of the organisation. This flexibility is not available with standard safety measurement techniques. However a move towards greater employee involvement as applied in this study is not a simple process as it involves a shift in management philosophy of occupational health and safety.

The paradigm shift from supervisory control over safety programs at a workplace to a consultative arrangements required for the introduction of a process similar to that used in this study has been slow (Krause, 1997). State governments in Australia have attempted to legislate involvement by employees in occupational health and safety matters, however until recently, the extent to which employees could add value has somewhat been speculative (Mayhew et. al., 1998). This study provides emphasis for employee involvement by identifying the knowledge they possess and their ability to articulate that in a way to assist in measurement of occupational health and safety performance.

The preliminary evidence suggesting that the EDC is a valid tool provides insight into the manner in which occupational health and safety is dealt with at a workplace.

The results obtained provide further endorsement of employee involvement and ownership in occupational health and safety matters. It also highlights the value that employees can add when involved in occupational health and safety in their workplace. While the results of this study do not provide conclusive evidence of employees' ability to develop valid and reliable tools to measure compliance with safe practices, the preliminary evidence suggests that this outcome may be possible.

Impact on Measurement of Occupational Health and Safety Performance

The measurement of health and safety has become increasingly important for organisations and governments alike (Frangou, 1999). With the realisation that the costs of workplace injury are escalating, various Australian government jurisdictions have developed means to measure an organisation's health and safety performance (Frangou, 1999). Governments continue to apply measures that can be easily attained and applied across all industries. For example, Lost Time Injury Frequency Rate (LTIFR) has long been regarded as the standard for the measurement of occupational health and safety performance and has been adopted throughout the world as the standard indicator of occupational health and safety performance (Gilmore, 1997). While these measures are easily attainable and definable, they provide little feedback to the workplace on how accidents can be prevented (Gilmore, 1997). With the increasing costs of workplace accidents effective, accurate and useable measures are required (Frangou, 1999; Gilmore, 1997).

As a greater understanding has emerged as to the role that human behaviour plays in workplace incidents, LTIFR and similar measures have come under scrutiny from occupational health and safety professionals and organisations (Krause, 1997; Geller, 1996). Although measures such as LTIFR are valuable measures for government, they do not identify the causes of accidents to facilitate continuous improvement in performance (Krause, 1997; Geller, 1996; Kohn, 1993; Jacobs, 1970). The greatest challenge faced by all measures of safety performance relates to what extent they are predictors of accidents.

This study attempted to measure the ability of the EDC to predict accidents by monitoring the mean compliance scores obtained throughout the study along with reported accidents. While it was found that on many occasions when compliance dropped below 80%, accidents occurred in the following fortnight the associations were by no means consistent. The findings could not be analysed statistically due to the rare nature of accidents at the workplaces and the large number of confounding variables as will be discussed. Furthermore, the analysis was performed on reported accidents. This was unavoidable however consideration must be given to the possibility of a number of unreported accidents that may have impacted on the results. Hence the ability of the EDC to predict accidents remains unclear. Further analysis is required to better understand the relationship between compliance scores and accidents. Further studies may wish to compare the compliance scores and accident rates over a longer period, or in a greater number of workplaces. Obtaining a larger frequency of accidents would lead to a better analysis of the relationship.

The study aimed to compare the EDC with conventional measures of safety based on the axiom that unsafe practices lead to accidents. While it was not possible to measure this with any validity over the short period of the study, the EDC may prove to be a promising measure of safety performance if compliance scores are able to the graphed and trends established over a longer period. This process would allow for a more frequent measure of performance than existing measures.

Impact of Incentive Schemes on compliance scores

The presence of a safety incentive scheme in one of the workplaces in the study allowed preliminary analysis of the impact that an incentive scheme has on compliance. Workplace B had been running a safety incentive scheme for the two years prior to the study commencing. The incentive scheme rewards workgroups who achieve certain lost time injury free goals. Rewards include coffee mugs, movie tickets, key rings and caps. The rewards increase in value as the length of injury free time increases (eg. key ring = 6 months Lost Time Injury free, coffee mug = 12 months Lost Time Injury free).

Some incentive schemes have been found to be moderately successful in numerous industries including manufacturing and construction in countries such as Finland and Israel, as well as the UK and USA (McAfee & Winn, 1989). One may assume that an incentive to work safely would deliver an increase in compliance with safe behaviour, however this does not appear to be the case for all types of incentive schemes. Research has found differing results in relation to the varying type of incentive schemes currently in place in many workplaces (Goodbourn, 1993). The findings from this study are consistent with other studies indicating that the lure of rewards for incentive schemes fail to increase the presence of safe behaviours at a workplace.

The mean compliance scores for the EDC and TDC showed no significant difference between Workplace B and C. On the surface, this would indicate that the presence of safety incentive schemes does not impact on the safe completion of tasks associated with ride on fork trucks. While no conclusions can be drawn from this small sample, the findings from earlier studies support the assumption that employees are not motivated by the presence of external, material rewards. It is argued that these type of rewards do not motivate people because internal motivators are much more powerful than external motivators (Bernstein et. al, 1991). Therefore, the compliance scores obtained in Workplace B could have been similar to Workplace C, due to the level of motivation to perform the work safely being driven by internal factors rather than the presence of a material reward.

The absence of significant differences between the workplaces could have been due to the high level of compliance with the required behaviours. Just as the high level of compliance had an effect on the inter-rater reliability, it also restricted the potential improvement due to the incentive scheme. This ceiling effect combined with the small sample size may have hampered attempts to detect improvement. Without EDC data prior the introduction of the incentive scheme it is difficult to identify any impact this had on compliance scores. It is possible that the compliance scores at Workplace B have improved since the introduction of the incentive scheme. However the results achieved through this approach do not exceed the performance achieved in organisations without incentive schemes.

The results support the assumption that rewards based on amount of time injury free will generally fail, as the goal doesn't appear to be related to the behaviours (Krause, 1997; Geller, 1996; Kohn, 1993). Current supporters of behavioural safety management do not generally endorse the use of monetary or material rewards (Geller, 1996). A greater emphasis rather is placed on the process of group goal setting and regular feedback (Geller, 1996; Goodbourn, 1993). Goal setting and feedback can be achieved through the development and implementation of an employee developed checklist similar to that used in this study.

Impact of Gender, Age and Experience on compliance scores

Demographic information was obtained from participants prior to the commencement of the study. Basic correlation analysis of these demographic variables and mean compliance scores was undertaken to provide insight into the impact that gender, age and experience have on compliance scores.

Gender differences did not play a significant role in determining mean compliance scores. This result should be read in context of the small number of females participating in the study. Driving of ride on lift trucks appears to be a male dominated task at the workplaces and therefore further studies of employee developed checklists should also be conducted on tasks that are inclusive of both genders.

Similarly to gender, the mean compliance score was not significantly affected by age. This result was interesting in light of the considerable research into the risks of injury faced by young workers (Deery, 1999; Mayhew 2000). The lack of statistically significant findings may be due to the licensing requirements of the task in this study. This resulted in all participants previously being assessed as competent by an accredited, external body and therefore there was a more consistent approach to the driving of ride on lift trucks.

The level of experience showed a small positive relationship with compliance score indicating that the presence of safe behaviours increases with time driving ride of lift trucks. This study did not allow for an in-depth analysis to identify possible reasons for this, however similarities can be drawn to motor vehicle driving behaviour. Previous studies have shown that novice drivers are over represented in road traffic accidents (Deery, 1999; Cooper, Pinili & Chen, 1995). Cooper et al (1995) identified that the over representation of novice drivers in road accident statistics was due to higher rates of at fault, or culpable involvements. The accident rates of novice drivers declined as they gained in years of driving experience (Cooper et, al., 1995). The findings from this study appear to support this through the lower compliance scores among those with the least experience.

These results should prompt further research into the licensing arrangement or requirements for ride on lift trucks. Parallel research by road safety researchers has found that crash involvement among novice drivers peaks some two or three years after learning to drive (Macdonald, 1995) prompting investigation into various probationary license initiatives. However, given the higher proportion of at-fault accidents amongst novices, any probationary license initiative must avoid viewing novice drivers as needing protection from the environment. Rather licensing schemes should encourage novice drivers to gain experience in a range of conditions (Cooper et, al., 1995). Alternatively workplaces may wish to develop a master and apprentice arrangement where novice drivers are partnered by more experienced drivers.

Experience in this study was measured on length of time the operator had held a license to drive ride on lift trucks. While this is a relatively simple measure it may not be the most accurate. The most appropriate index of experience should reflect the amount of driving performed in terms of hours. This would more accurately reflect skill acquisition in relation to the task and address the relationship between age and experience which may have impacted both results.

In summary, the analysis of demographic variables indicates that there no evidence of a relationship between gender and compliance or between age and compliance. A small positive relationship was found between experience and compliance, however, further analysis of the relationship between demographic variables and compliance scores requires more rigorous testing with larger samples before any of the above findings can be considered conclusive.

Limitations

The results of this study, while promising overall, must be read in light of a number of limitations. The first such limitation prevents claims of anything but preliminary evidence of validity of the EDC. Ideally the results from the EDC would have been compared against those obtained from a gold standard which could be either a previously validated checklist or a robust measure of accident rates. In the absence of the former and in view of the limitation of accident rates as measure of compliance, this study cannot conclusively conclude that the EDC was valid. Furthermore the difficulty in measuring reliability within this relatively homogenous sample does not allow for conclusions in regard to the reliability of the EDC and TDC.

The inability to draw conclusions regarding the validity and reliability of the EDC and TDC should not be read as an absence of either. The use of theory from the licensing process and manufacture instructions should result in a valid checklist. This simply remains untested in the field. The strong preliminary evidence of validity obtained from analysis further supports the conclusions made above. The disappointing reliability analysis suggests that observer training and sampling should be addressed. There is a possibility that the training was not clear on how to rate an activity as compliant. This was particularly evident when some behavioural items on the checklist were exhibited a number of times over each observation. For example, the item 'Look prior to initiating movement'. If this behaviour was exhibited on a majority, but not necessarily on all occasions in the one observation session there was some flexibility as to how to rate it (eg, fully compliance, not compliant). This is supported through analysis of the raw scores indicating that the observers consistently scored the same observation within one point (6.25%) of each other. While the ICC did not statistically support a conclusion of reliability, this finding can be explained by the high degree of homogeneity of the sample in terms of compliance with safe behaviour.

An unavoidable limitation of the study concerned the participant's involvement in the development of the EDC. It was considered crucial for these participants to be regular uses of ride of lift trucks. However, due to the licensing requirement for this piece of equipment in Australia the focus group contained operators who would have had a knowledge of the theory used to develop the TDC. The high correlation obtained during the observations between the EDC and TDC may have been in part due to this. However, it is unlikely that employees with no prior exposure to safety or licensing requirements could be sourced to developed a suitable checklist. It is also possible that those who volunteered were more interested in improving the health and safety of the workplace and could possibly have caused a participation bias. As stated, this was unavoidable in the design of the study.

The small number of female participants, along with a crude measure of experience may have impacted on the results obtained from the analysis of demographic variables. The small number of females eligible to participate in the study is likely to be primarily due to the task itself. The index used for experience of participants did not take into consideration the time spent driving a ride on lift truck. While this may be seen as a limitation, the difficulty in accurately capturing experience in terms of hours would prevent this from being used in a similar study. While a more detailed cohort study design may be able to measure experience more accurately, the expense involved in such a lengthy study may be prohibitive.

Considerations for Future Studies

The results obtained in this study have been dependant on a number of issues. The first of these is the chosen task itself. The task was deliberately chosen because it was simple to observe. The task of driving a ride on lift truck is simple as the same 'rules' can be applied to all situations. The difficulty with observing tasks such as manually lifting (i.e. manual handling) is that the employee is required to make a decision prior to each task. The same lifting technique may not be appropriate in all situations, hence a decision must be made. The decision is based on such factors as the location, weight and dimensions of the item to be lifted. As a result, each lift may be performed in a different way, using a slightly different technique. While some would argue that the principles (eg. keep back straight, lift with your legs) apply across all situations, the ability of an untrained observer to recognise these subtleties is limited. Therefore, the use of employee developed checklists is, in the researcher's option, limited to rule based, rather than concept based tasks. While this does not detract from the results of this study, it may limit the extent to which the model from this study can be applied. While manual handling may be an exception, a majority of workplace tasks, particularly in heavy industries could be measured through a checklist similar to that developed in this study.

The results of this study will assist workplaces in a number of ways such as improving safety performance and changing the way in which occupational health and safety principles are applied to the workplace. The findings from this study should encourage workplaces to empower employees by involving them in the development of flexible, workplace specific and relevant measures of safety performance. Furthermore, it supports the use of what have become known as proactive measures of safety (Goodbourn, 1995; Geller 1996; Krause 1997). Such measures focus on the workplace strengths, rather than focussing on weaknesses of the safety system, as traditional measures do.

An element of this study that may impact on the implementation of the model in the workplace, is the nature of the workplaces involved in the study. Both workplaces by design, where essentially 'controlled' environments. That is, all of the tasks of interest to the study were performed within the same four walls. This allowed the observations to be easily completed and also provided a steady stream of feedback from other employees relating to the task. While the type of working conditions present in this study is not uncommon, it would be erroneous to ignore those who do not work in a single location. The measurement of safety through compliance checklists may not work as effectively for small groups working in remote locations where management control and contact is reduced. Alternatively, contractors in the construction industry for example, may not be suited to this type of measurement for the same reason. In both the exceptions noted the presence of an external observer and a peer observer may have an impact on the results. The application of the study design in larger organisations allowed the presence of an external observer to be somewhat inconspicuous, therefore limiting the likelihood of confounders such as the Hawthorne effect.

An impact on both the results and the application to other workplaces was the use of volunteers in the study. It is possible that those who volunteered were more interested in improving the health and safety of the workplace and could possibly have caused a participation bias. While this was unavoidable in the design of the study, it may have impacted on the results obtained. When applied outside a research environment, the intent would be for all employees involved in the task to be observed. This would ensure the maximum benefit was achieved.

As is often the case in applied research, true experiments are not feasible, which means there may be expectations for change in the dependent variable other than the independent variable. In the present study, one could ask whether or not commitment to implementing a process is enough to produce the observed improvements in performance. However, research does indicate that improvement occurs at the commencement of intervention, not the commencement of resources, which could be six months earlier (Krause, 1999). Further studies demonstrate that change in safety behaviour coincides directly with behavioural intervention efforts (Sulzer-Azaroff et al., 1990; Komaki et al., 1978).

CHAPTER SIX

CONCLUSION

The results of this study present a number of benefits for workplaces including the development of employee involvement in occupational health and safety measures, employee involvement in goal setting, availability of a proactive measure of occupational health and safety performance, and an inexpensive and flexible measure of occupational health and safety performance. Involvement of employees in an organisation's occupational health and safety interventions has found to be a benchmark for good occupational health and safety performance. It is believed that until organisations gain a better understanding of the causes of workplace accidents, instead of seeing them as an unpredictable and unfortunate occurrences, transformational change in occupational health and safety will not occur. A shift from viewing employee behaviour as a cause of accidents and seeing it as a control point in a complex sequence of events is required for compliance checklists to become more prominent in Australia.

The findings of the study support the hypothesis that employees possess the knowledge, skill and ability to develop a compliance checklist that will assist in providing organisations with occupational health and safety measures in a timely manner. The additional benefits of implementing a similar process include flexibility to modify the measurement focus based on need. It is this flexibility, along with the employee involvement that will deliver benefits to an organisation in terms of improved safety performance.

APPENDIX I

A pilot study of an employee developed observational tool as a valid and reliable measure of organisational safety

Participant Information and Consent Form

You are invited to participate in a study looking at developing and testing an employee developed tool to measure the presence of safe work practices. This study is being conducted by Matt Wallace, currently studying at Masters of Health Science through Edith Cowan University (ECU). The knowledge gained from this study may assist in better understanding and measuring the level of occupational health and safety within your organisation.

If you agree to participate you be invited to a focus group containing fellow employees from your workplace. The focus group should take no more than one and a half hours to conduct. The aim of this focus group is to develop a list of critical behaviours that are essential for safe completion of a task.

You may be asked for further comments after independent reviewers have provided feedback on the list, however you are under no obligation to do this. Your permission will be sought prior to any further involvement in this study.

This list will then be used to measure compliance at two other Victorian manufacturing workplaces. Individuals at these workplaces will be assessed against these criteria to determine whether they are performing the task in a safe manner. Observations will be recorded at these workplaces over the next 6-12 months to obtain sufficient data.

Your participation in this study is voluntary. Your name will not be recorded on any material associated with the study and you will not be identified. If you decide to participate, you may choose to withdraw from this study at any time. Should you wish to withdraw contact should be made with the researcher to ensure observations do not continue. The ethics committees of Edith Cowan University have approved this study, however should you wish to discuss this study with an independent person, please contact the Research Supervisor (details below).

Upon completion of this study, a copy of the results will be made available to participants. If you wish to receive the results, please indicate on the tear off sheet over the page.

Researcher

Matt Wallace

(03) [redacted]

Research Supervisor

Dr. Sue Nikoletti
Edith Cowan University

Phone: (08) 9273 8182 (work)

A pilot study of an employee developed observational tool as a valid and reliable measure of organisational safety.

Participant Information and Consent Form (continued)

I ……………………………………………….. have read the information on the study
(please print name)

"A pilot study of an employee developed observational tool as a valid and reliable measure of organisational safety" described above and any questions I have asked have been answered to my satisfaction. I agree to participate in the focus group to generate a list of critical behaviours, realising that I may withdraw at any time. I understand that if I have any concerns or further questions I may contact the researcher or Supervisor listed on the information sheet given to me. I agree that research data gathered for the study may be published provided I am not identifiable.

Participant's Signature

Witness (print name) (signature)

Date

A pilot study of an employee developed observational tool as a valid and reliable measure of organisational safety

Please send a copy of the results to:

Name

Address

Post Code ____

APPENDIX II

A pilot study of an employee developed observational tool as a valid and reliable measure of organisational safety

Participant Information and Consent Form

You are invited to participate in a study looking at testing at a tool designed to observe work practices. This study is being conducted by Matt Wallace, currently studying at Masters of Health Science through Edith Cowan University (ECU). The knowledge gained from this study may assist in better measuring aspects of workplace practices.

If you agree to participate you will be observed undertaking a specific task on greater than five occasions over the next 6- 12 months. The observations will be conducted by a number of people and you may not always be aware of when you are being observed.

To ensure confidentiality, no names will be recorded. Instead, a number will be used to code all forms. This means that you will not be identifiable in any report or publication that may be written for this study.

Your participation in this study is voluntary. If you decide to participate, you may choose to withdraw from this study at any time. Should you wish to withdraw, contact should be made with the researcher to ensure observations do not continue. The ethics committees of Edith Cowan University have approved this study, however if you wish to discuss any aspect of this study with an independent person, please contact the Research Supervisor (details below).

Upon completion of this study, a copy of the results will be made available to participants. If you wish to receive the results, please indicate on the tear off sheet over the page. In addition, you have the opportunity to attend a de-briefing session at the conclusion of the study.

Researcher

Matt Wallace

[redacted]

Research Supervisor

Dr. Sue Nikoletti
Edith Cowan University

Phone: (08) 9273 8182 (work)

A pilot study of an employee developed observational tool as a valid and reliable measure of organisational safety

Participant Information and Consent Form (continued)

I ……………………………………………….. have read the information on the study
(please print name)
"A pilot study of an employee developed observational tool as a valid and reliable measure of organisational safety", described above and any questions I have asked have been answered to my satisfaction. I agree to participate in this study, realising that I may withdraw at any time. I understand that if I have any concerns or further questions I may contact the researcher, or Supervisor listed on the information sheet given to me. I agree that research data gathered for the study may be published provided I am not identifiable.

Participant's Signature

Witness (print name) (signature)

Date

- -

A pilot study of an employee developed observational tool as a valid and reliable measure of organisational safety

Please send a copy of the results to:

Name

Address

Post Code ____

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