Achieving Best Practice in OHS

Improving Occupational Health and Safety (OHS) by the application of knowledge management principles.

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A thesis submitted in partial fulfilment of the requirements for the degree of

Doctor of Business Administration

Faculty of Business and Economics

Monash University

August 2013

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ABSTRACT

Safety impacts on the lives of every person, every day, at home, travelling to work, at work and in recreation. Unfortunately, at times when safety breaks down people get injured and sometimes are killed. Work is an all too common place where these break downs occur. Every year in Australia, hundreds of people die at work and many more are permanently disabled; their lives and the lives of those around them will never be the same again.

There have been many approaches by state and federal governments, unions and organisations to try and reduce this avoidable financial and moral cost to both society and workers alike. There are acts and regulations in every state with strict rules and harsh penalties for non-compliance. There are thousands of pages of associated codes of practice, guidelines and standards that support these legal requirements. Unions have worked hard for many years to push occupational health and safety through governments and organisations. Organisations have implemented many procedures, policies and standards themselves recognising the huge financial and legal exposure of poor safety. There has been many days of safety training both internally and externally provided to thousands of employees, which continues every day. Safety leadership has been driven through many large organisations to ensure management and employees alike understand the importance and reason for safety. Technology has played an important part contributing to drastic improvements in both mobile and fixed equipment to minimise the risk of an injury in such higher risk situations. In more recent times, concepts like behaviour-based safety and positive performance indicators have been introduced to improve safety. Indeed, all of these approaches have reduced the risk of injury in the workplace significantly. Nevertheless, hundreds of injuries and serious incidents occur every day, many of which could have been avoided. Hence, more needs to be done and the vision of an injury free workplace should never be forgotten.

This study examines safety management and current practices to see if there is a better way than current approaches and how safety can be improved further from an overall strategic approach. It investigates whether another field, knowledge management, can be used to improve safety management performance. To do this, firstly an initial conceptual model was developed after an exploratory analysis and literature review. A comprehensive longitudinal study was then carried out in a large national Australian organisation to test the research question as to whether the practical application of knowledge management principles to safety can improve safety performance. The study involved methodical triangulation to combine a

range of qualitative and quantitative data. The study, which ran over three years, positively supported the research question that knowledge management can be used to improve safety performance. This was achieved through applying sixteen practical safety applications using knowledge management principles. From this finding an overall framework and approach was developed which can be used by other organisations to improve their safety performance even further towards best practice. It is hoped that through this outcome that many other serious injuries and incidents are prevented, creating a better society and saving the lives and livelihoods of many more workers.

COPYWRITE & DECLARATION

The work presented in this thesis, to my knowledge and belief, contains no material which has been previously published or written by another person, except where due reference is made in the text of the thesis. I hereby declare that I have not submitted this material, either whole or in part, for a degree or diploma in any university of other institution.

……..

Clifford Verhagen

DEDICATION

It is with great respect that I give this dedication to my mum and dad for their unrelenting support and love and for Luke and Maeya whom I give my support and love and Veronika for my inspiration.

ACKNOWLEDGEMENTS

I firstly would like to thank my supervisor, Professor Amrik Sohal for all his support, guidance and most of all patience in helping me to complete this work. Amrik would always be considerate of my circumstances which have changed many times over the several years I have been working on this thesis, he would be there to follow up and drive me further forward. Without him this work would never have been completed, particularly not to the academic standard and rigor required for such a piece of work.

I would like to thank all the safety professionals and representatives I have worked with over these years. I would like to thank Barry Sherriff (Freehills) who has inspired me through his passion in safety and vast knowledge of safety legislation and leadership. I would also like to thank Yossie Berger from the AWU who has inspired me with a different perspective and approach.

I would like to thank Visy Industries and in particular George Haggar who gave me the opportunity to integrate and undertake the work as part of my employment. George gave me a lot of latitude and autonomy to conduct my research, without which the work could not have been completed. I also thank Kevin Campbell from Visy who under tough circumstances allowed me to continue and complete my study.

I would like to thank all those who participated in the surveys and questionnaires from Visy, whom gave their time, opinions and honest feedback which added significantly to the value and benefit of the final thesis.

Finally, and most of all, I would like to thank my parents for their support both physically and financially throughout this study and research. They have always allowed and supported me to achieve my greatest potential in my studies.

DISCLAIMER

The thoughts, opinions and conclusions contained in this research do not reflect the opinions and standings of the companies represented. The information and figures contained cannot be reproduced or used as evidence against the companies represented in any way. Any use of the information may only be done through the approval of the author and companies for which they pertain to.

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CHAPTER 1

INTRODUCTION

Occupational Health and Safety (OHS) or 'safety' as it is commonly known, is a core part of our society. Nobody wants to sustain an injury that can affect their livelihood and well-being. A number of countries have established government departments to help regulate and improve the safety of people in society, particularly at work. It is commonly known that the manufacturing industry is a significant source of workplace-related injury and has been the focus of many government initiatives, examples include the 'Focus 100 Program' by the Victorian Workcover Authority, the 'National Manufacturing Week' in New South Wales and the 'Site Specific Targeting' program by the Occupational Safety and Health Administration in the USA.

In Australia, every state and territory has specific regulations for safety which apply to their respective jurisdictions. There are also hundreds of Australian standards and Codes of Practice which help to define the safety requirements for workplaces, products and services. Most large Australian employers have an OHS policy and an associated management system implemented to incorporate the requirements of these acts and regulations within their organisations. However, despite all this emphasis, evidence (SafeWork Australia, 2012; Mayhew & Peterson, 1999) shows that workplace-related injury and disease still account for more deaths and injuries than in any other area of our society. Due to this and the breadth and scope of activities and risks employees are exposed to, it is not possible to stipulate specific safety requirements in legislation. Hence, regulators are using a risk management approach providing broad safety requirements for employers with only guidelines for specifics.

The author argues in this research that without the correct knowledge and skills, this approach is flawed. The author also suggests that knowledge and the way in which it is managed (knowledge management), has a key role to play in improving the OHS of everyone in their working lives, particularly those working in a high risk environment such as manufacturing in Australia. The knowledge management principles will be applied as a framework and an implementation program developed with respect to safety. The researcher has had over 20

years' experience in the safety field, hence is able to integrate both theory and practice of the two topics (knowledge and safety), to investigate the research questions stated in section 1.2 below.

1.1 Background of the Study

Safety is a very common term used in the modern world. Safety impacts everyone, every day, whether it be whilst driving a car, travelling on public transport, at work, at home or during leisure time. As a result, there are many professions and resources dedicated to looking after and improving the safety of others in and out of workplace. Indeed whole organisations exist for the purpose of safety, including government organisations and enforcement agencies, product manufacturers, consultants, trainers and educators. The highest priority and political emphasis for the union movement has been based on safety. In fact, unions were the first to establish safety legislation in Australia and many other countries (Quinlen, 2009). Almost every major organisation has safety high on its list of values and objectives. Millions of dollars are spent on safety equipment and workplace improvement for safety every year. There are hundreds, even thousands, of pages of safety acts, regulations, codes of practice and standards to improve safety and minimize the risk of injury. This is not to mention whole industries that have been created to treat injuries resulting from poor safety.

However, despite all of the time, money and resources spent on safety, hundreds of people die every year and thousands more are permanently injured due to poor OHS (ASCC, 2006). The cost to society is estimated at over $30 billion a year in Australia alone (NOHSC, 2002). In addition to this is the significant personal and emotional burden, not only on those injured but also their friends and family, particularly when someone has passed away or is permanently injured unexpectedly.

Although with all the regulation, acts, legislation etc., safety remains to be a recognised profession (Robotham, 2000). One reason for this is that academically safety as a whole is not a well-researched and understood discipline (Quinlen, 2009, Mayhew and Peterson, 1999). There are many examples in academia where specific safety is addressed in a particular circumstance or industry, such as mining or vehicle safety (Braithwaite, 1985, Murray et. al, 2008, Williamson, 2009). However, safety is often considered as a part of human resources and overall as management research (Clissold, 2006). There is very little research into the overall discipline and how best to approach and apply safety management in practice to

improve safety performance. Some safety professionals have written books about safety but without fully analysing the "before" and "after" situations and fully describing the interventions that would stand up to academic rigor and statistical discipline (Winters et al., 2011; Roughton, 2002; McSween, 1995; Waring, 1996; Weinstein, 1997). Much of the research reported is typically based on a one point in time questionnaire or is a snap shot study to make overall conclusions about safety (Sexton et. al., 2006). There is even less research that examines the strategies and tools that can be applied to safety management from other management disciplines.

Hence, there is a need for more rigorous academic research in safety and even more so a need for longitudinal studies examining the overall practical application and implementation of safety management strategies, perhaps using the knowledge gained from other management disciplines.

1.2 Overall Research Objectives or Research question

The framework developed in this research for the application of knowledge management to OHS is used to test the main research question:

"Is the application of knowledge management principles positively related to the improvement of Occupational Health and Safety in a large Australian organisation?"

Five other key research questions which this research addresses are:

1. What signifies a positive improvement in safety?
2. What is knowledge management?
3. What are knowledge management principles and how are these applied to safety?
4. What is the difference between a knowledge management approach and the existing legislative approaches?
5. Is the knowledge management approach better than the existing legislative approach?

1.3 Scope of the Research

It is important to recognise the limitations of the research, in that it will concentrate on the manufacturing industry within Australia. The main study is conducted through one organisation, Visy Industries, recognising that Visy is a very diverse organisation covering:

- Recycling of commingled waste (glass, paper and steel),
- Forestry,
- Mass paper production,
- Large scale mass production of boxes,
- Automation and robotics,
- Beverage cans,
- Beverage plastic bottles,
- Beverage Cartons,
- Printing and associated chemicals,
- Food cans,
- Industrial cans,
- Plastic packaging,
- Logistics,
- Finance and other support functions.

The following points represent the defined boundaries and scope of the research:

- The research reported is related to Knowledge Management and Safety Disciplines
- Safety is studied from a human resources perspective
- A systems focus that ensures improvements are maintained
- The thesis contributes significantly to the field of safety management research
- The research is confined within the two manufacturing organisations (Pilkington and Visy) studied and associated operations.
- The study is subject to many external events which may change the environment in which the research takes place.
- There are many variables that are beyond the researcher's control which could affect the outcomes. This includes global economic influences; significant safety incidents; and changes in management, industry and changes in government legislation that may affect the company.
- The researcher is an integral part of the study and not simply an observer.

- The study is more concerned with the generation of ideas and a conceptual framework based on knowledge management principles and applying these in practice.

1.4 Contribution of the Research

The contribution of this research is significant not only to safety professionals as the title of this thesis may suggest but also to other practitioners involved with safety and knowledge management such as those involved in: Human Resources, Production Management and government organisations. This research will help provide them with further insights into better ways of managing safety than simply trying to interpret and follow legislation as is the practice in many organisations (Mischke et al., 2012; Erickson, 1996). This research also provides a link between theory and practice in the areas of safety and knowledge management and shows how the two complement each other. It is anticipated that the findings of this research will help improve safety not only in manufacturing organisations but also within the broader community. It will also add to the academic knowledge and research in the field of safety management to improve its status and standing in the academic area.

1.5 Significance

The significance of the field of research cannot be under-estimated. The occupational health and safety of every employee in a company is critical. It has serious impact on the individual and the company as a whole. In Australia, the probability of suffering a workplace injury is 1 in 12, while the likelihood of suffering a permanent disability caused by a workplace injury is 1 in 200. On a global scale, approximately 1.1 million people die each year in workplace related injuries (NOHSC, 2002). Information released by the Industry Commission in 1995 stated that there were 2,700 work-related deaths and 650,000 injuries annually in Australia. The total economic cost from workplace injuries in Australia for the 2005-06 financial year was estimated at $57.5 billion, representing 5.9% of GDP for the financial year (Kumar, 2011). Ellis (2004) also suggested that there had been an improvement but the rate of improvement was not fast enough.

This study predominantly explores the manufacturing industry as it is still seen as the primary area for safety focus as employees are sometimes exposed to great risk, and the interaction between person and plant where injuries occur is more common. Based on the latest data

available, the manufacturing industry still has by far the highest number of serious non-fatal injuries, 20.2%, see Table 1.1 (ASCC, 2006).

Industry	Fatal		Non-Fatal		Total	
	Number of Claims	% of Claims	Number of Claims	% of Claims	Number of Claims	% of Claims
Agriculture, Forestry and Fishing	14	0.0	4610	3.5	4625	3.5
Mining	7	0.0	2440	1.8	2445	1.9
Manufacturing	36	0.0	26660	20.2	26695	20.2
Electricity, Gas and Water Supply	np	np	750	0.6	750	0.6
Construction	50	0.0	14080	10.7	14130	10.7
Wholesale Trade	9	0.0	6655	5.0	6665	5.0
Retail Trade	12	0.0	12480	9.5	12495	9.5
Accommodation, Cafes and Restaurants	6	0.0	6260	4.7	6270	4.7
Transport and Storage	45	0.0	10720	8.1	10765	8.2
Communication Services	3	0.0	1180	0.9	1185	0.9
Finance and Insurance	2	0.0	1155	0.9	1160	0.9
Property and Business Services	15	0.0	8940	6.8	8955	6.8
Government Administration and Defence	11	0.0	5145	3.9	5155	3.9
Education	4	0.0	6425	4.9	6430	4.9
Health and Community Services	5	0.0	16025	12.1	16030	12.1
Cultural and Recreational Services	5	0.0	2545	1.9	2550	1.9
Personal and Other Services	11	0.0	5280	4.0	5290	4.0
Not Stated	1	0.0	455	0.3	460	0.3
Total	236	0.2	131820	99.8	132055	100.0

Table 1.1: Fatal and non-fatal injuries in Australia 2006/7 (Source: ASCC 2006)

However, there are many other aspects to consider, apart from just injury statistics, as the following summary of an analysis of a major case study organisation shows (Visy Industries up until December 2004, the commencement of the study was the largest packaging and recycling

company in Australia with over 5,000 employees, over $2.5 billion in turnover and six major divisions, see Appendix 1.1 for more details). The implications at several levels is highlighted:

1. Financial Costs
    - 2,162 Workcover Claims over the three year period: January 2002 to December 2004.
    - Average claim costs over $13,000 during this time period
    - $28 million in claims paid out from the national insurer over this three year period
    - Visy's Workers Compensation costs amounted to $46 million over the three year period.
    - Actual cost to the business was 3 – 4 times greater based on accident iceberg noted in Figure 2.3 presented in chapter 2.

2. Resource Costs
    - Average 17 days taken off for each claim by the injured party.
    - 36,754 days lost due to injuries over the three year period
    - On average 51 people out of work all year, every year due to injuries.

3. Legal Implications in different states of Australia

    Victoria
    - The Victorian OHS Act includes specific offences for senior officers.
    - Sections 144 and 145 of the Act establish that a senior officer can be found guilty of an offence if there has been a failure to take reasonable care.

    South Australia
    - Directors and senior officers of companies will face maximum fines of $500,000 and/or imprisonment of up to 20 years if they are found responsible for the death of employees

    New South Wales now in the Work Health and Safety Act (2012)
    - Directors would not be able to rely solely on executives and managers' assurances of OHS compliance, but would need to satisfy themselves of corporate and individual compliance via informal reviews and audits of OHS management systems.

The above Figures help to explain why industry and governments alike are looking for ways to improve OHS in the workplace. This research provides a greater insight into an approach to

improve safety by the application of knowledge management techniques. The research findings can be used by industry and government departments to enhance existing safety approaches and the techniques applied.

1.6 Theoretical underpinning of the Thesis

Upon reviewing existing literature, it was found there was considerable research on safety management specifically and many books written about different aspects of safety. However, the approaches to safety management appeared to be very similar and involved defining a series of safety components that make up different aspects of safety in the workplace. Some authors (Reiman & Rollenhagen, 2011; Roughton, 2002; Weinstein, 1997) commonly provide examples and experiences in each of the topics chosen and then link all the aspects into a safety system, either one they had developed or a predefined one such as the Australian Standard 4801 - Safety Management System or the National Occupational Health and Safety Commission (NOHSC) guidelines in the USA. However, upon examining these approaches more closely, there were five fundamental concerns or issues identified by the researcher:

1. Lack of coverage of injury management in safety systems.
2. Limited practical evidence of safety systems implementation and success.
3. Lack of an overall framework or approach to safety improvement.
4. Very few safety performance measures applied, particularly those that would stand up to academic and statistical rigor.
5. Limited use of other management disciplines to enhance safety management.

The first major concern was that typical safety management approaches and systems do not cover injury management in any real detail, indeed AS/NZS 4801:2001 and the NOHSC guidelines mentioned above do not cover it at all. This is seen as a significant flaw by the researcher, as the treatment of an injured person after an accident is critical to the safety culture in the organisation. More importantly in practice, it is found that the safety professional has to undertake these injury management duties in his/her organisation or at least to coordinate these across the organisation.

Secondly, many of the books published provide little hard evidence of the application and success of the approaches they are recommending to be used in the workplace to improve OHS. For example, incident investigation is presented simply as a form explaining how to fill it in and some authors would go into a little detail of the steps to take in practice. Few authors

actually show the success and improvement of using the approach in practice (Erickson, 1996, Weinstein, 1997).

Thirdly, most of the books do not provide an overall approach or a framework that could be used (Reiman & Rollenhagen, 2011; Roughton, 2002, Krause & Finley, 1993, Weinstein, 1997). They simply use the elements of a standard and do not provide a strategy or approach to implementing these in practice; it is often assumed that these elements need to be implemented at once. The only real framework or approach often presented is the over simplistic, continuous improvement cycle (AS/NZS 4801:2001, Australian Standards).

Fourthly, very little attention is paid to safety performance and measurement, and the measures suggested are often simple injury statistics. Those that are presented lack academic and statistical rigor. Indeed the researcher has presented at several conferences on this exact issue to raise awareness and understanding (Verhagen, 2001).

Finally, very little evidence could be found on the use of other management approaches which can be implemented to benefit safety management. What evidence could be found was based around computer systems and databases (Allenby, Collipi, Nargis & Jones, 2002).

Hence, research in this area can go a long way in addressing the flaws found in the existing literature. With respect to looking for other management approaches which could benefit safety management, information technology was examined but it was considered by the researcher to be more an application rather than a management approach. There are some good examples of the application of quality management to safety management (Weinstein, 1997) and integrating environment and safety management (Allenby et al., 2002). Certainly the learning organisation concepts can provide considerable benefit with respect to safety management and indeed the preliminary research is related to this area. Examining the safety management literature, particularly definitions, the word ‘knowledge’ came up frequently. For example, Blewitt and Shaw (1997) states that it is part of the safety professional’s role to spread safety knowledge (see section 2.2.1 in chapter 2).

The literature review indicates that knowledge has been a topical area of research in recent years (Dalkir, 2013; Easterby-Smith & Lyles, 2011). Consequently, knowledge management was identified as a concept that could be applied to safety management. A comprehensive

literature review was conducted on knowledge management. This analysis provided a strong connection between knowledge management and computer systems, even more so than safety management. Hence, the emphasis of the research changed from its initial focus on learning organisations and quality management to knowledge management.

Hence safety management and knowledge management were chosen as the main focus of this research project. The whole research was then focused around firstly addressing the flaws in the common safety management approaches and whether the application of knowledge management to safety could actually improve performance.

1.7 Research Methodology

Many safety researchers and practitioners alike have looked towards management research to advance the field of safety. The most common approach used in management and indeed safety research is quantitative (surveys and questionnaires) (Myers, 2013; Guldenmund, 2000). However, such approaches have their limitations;

1. These focus only at one point in time,
2. They are based on only those who respond,
3. They can be directed and skewed based on how the questions are worded, and
4. They do not allow for flexibility and exploration into new concepts and ideas.

To help overcome this final limitation, often quantitative case study research is used. This is more common in management but also exists in safety. However, even such a research approach has its limitations (Burke, Sarpy, Teslub & Smith-Crow, 2002; Griffin & Neil, 2000; Myers, 2013);

1. It is still usually at one point in time,
2. There is often a bias based on participation, and
3. It often lacks subjective evidence.

To overcome these limitations, various methods were used in this study involving both qualitative and quantitative data. In knowledge management, a whole range of techniques were used, particularly case study research and computer based techniques. Hence, to obtain rigour and quality (Anfara, Brown & Mangione, 2002), this research used methodical triangulation incorporating a variety of approaches. All these approaches have been combined into a research design with its core being based around an action research approach, see Figure 1.1 below which is described in Chapter 3. Due to the level of depth and analysis required to

integrate all these techniques, the whole approach is integrated into one major case study of a large multinational corporation in Australia, namely Visy Industries.

This research is broken into three phases. Phase I was a comprehensive literature review which is updated throughout the research. Phase II involved the exploratory phase where two case studies and the conceptual framework was developed. Phase 3 was the main component of research and forms the major case study, consisting of two climate surveys and 16 practical applications.

1.8 Data analysis

Quantitative data was gathered through two climate surveys whilst qualitative data was gathered through interviews. Hence a range of data analyses techniques were used as suggested by various authors (Bawden, 1991; Griffin & Neil, 2000; Hofmann & Stetzer, 1996; Ticehurst & Veal, 2005; Yin, 1984; Myers, 2013). These are described in more detail in chapter 3.

The quantitative data is analysed in terms of trends and differences over time. Being a longitudinal study involving two surveys conducted in 2005 and 2008, t-tests are used to identify significant differences over time. For the performance measures used in the study, a simple comparison of the differences in the measures is used as several of the measures are discrete and cannot be proportioned, for example, one can only have one risk assessment, one cannot have half a risk assessment.

The qualitative data from the interviews in the climate surveys was transcribed and analysed using an inductive technique as recommended by Strauss and Corbin (1998). This is where the researcher examines the transcribed text and in the context of the research and literature, develops a series of common themes. These can then be broken down even further into sub-elements or themes.

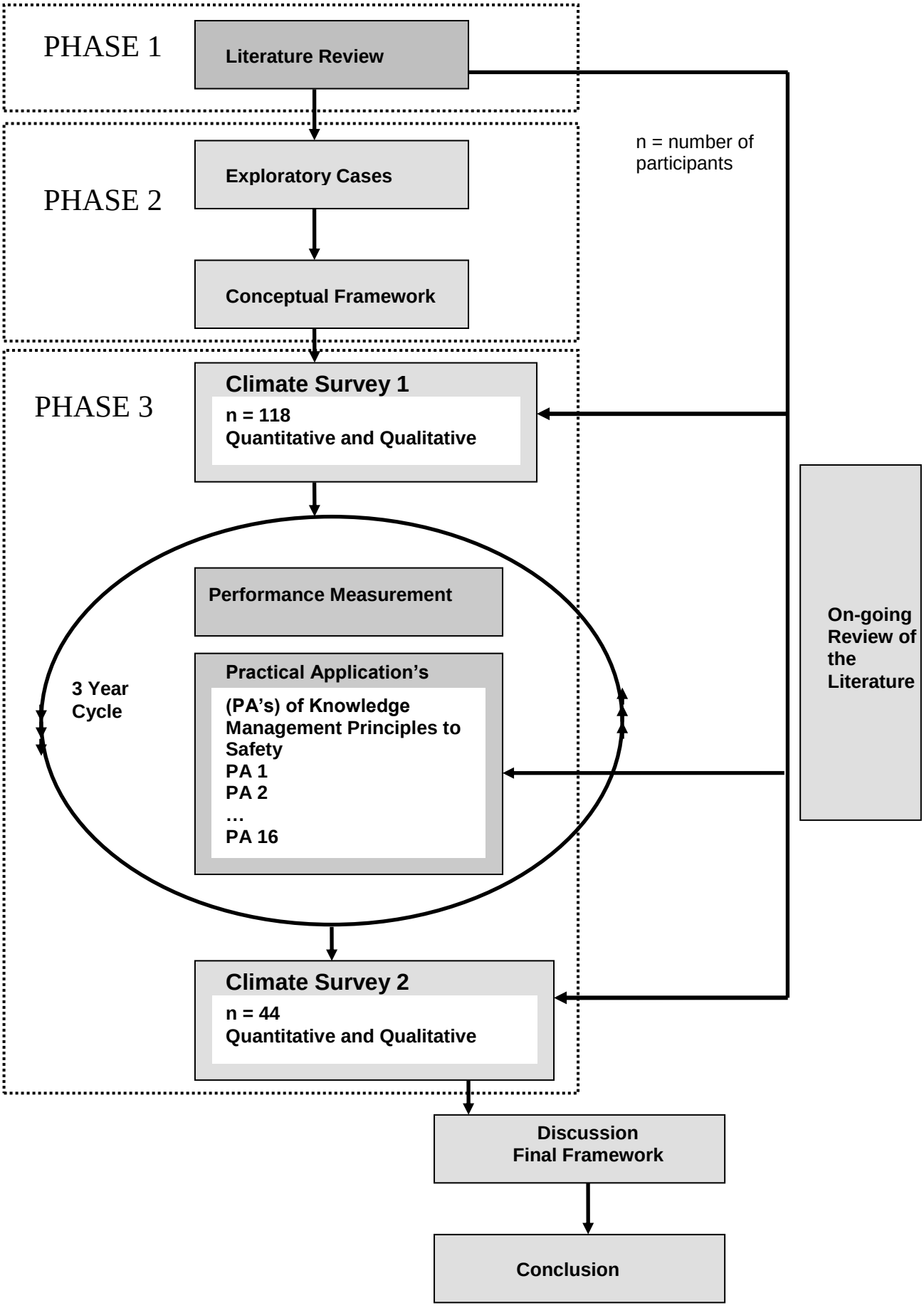


Figure 1.1 Research Design

1.9 Assumptions, Limitations and Delimitations of the Study

1.9.1 Assumptions

The following assumptions are made in the conduct of this research:

- Respondents from one climate study to the next can be considered to be consistent in their understanding and response.
- Respondents understood the questions and responded on their own free will.
- Respondents were sincere and accurate in their response and could accurately portray the safety of their area of involvement and responsibility.
- The data analysed for performance management is assumed to be consistent and accurately entered for the measure of improvement, such as workplace audits.
- The researcher's involvement in the study has not biased or grossly affected the findings.
- The changes attributed from one survey to the next were largely due to the practical applications implemented rather than other environmental factors.

1.9.2 Limitations

This research recognises the following limitations:

- Generalisation of the results to other organisations should be done with caution, particularly when they are associated with industries not covered by the organisations studied in this research.
- Generalisation to other jurisdictions of safety which may have vastly different legislation and cultures towards safety, such as in developing countries.
- The improvements made may also be due to other environmental factors, such as injuries reduced due to the introduction of more automation or a new facility.
- The inductive and numerical analysis of the climate surveys is based on the perceptions of respondents.
- The conclusions deduced from the theory and practice may also be limited by the researcher's experience and knowledge in the field.

1.9.3 Delimitations

In order to limit the scope and breadth of this study, the following delimitations have been applied:

- The study is concerned largely with an Australian manufacturer and its associated activities.
- The study does not go into great depths about specialist areas of safety such as detail on chemical management but is more concerned with an overall framework.
- The study does not go into any detail with respect to specific risk areas, but rather calls upon them for assistance. For example, issues relating to working in confined spaces or working at heights.
- The study is more concerned with the macro level of safety management and knowledge management rather than specific detail, for example, data mining for knowledge management.

1.10 Thesis Structure

The structure of this thesis principally follows the research design incorporated into the requirements of academic discipline.

Chapter 2 is a detailed literature review examining the safety and knowledge management fields, how they complement each other and what research is available in the combined space.

Chapter 3 describes the research methodology including the investigative techniques and why they were chosen and how they are incorporated into an overall research design.

Chapter 4 is a preliminary analysis and development of a conceptual framework. This chapter involved two explorative case studies that begun in the organisational learning space which then shifted into knowledge management as a more appropriate discipline for safety management. The chapter then examined different frameworks or approaches for safety management and knowledge management and how they can be combined into one framework.

Chapter 5 is the first climate survey which establishes the benchmark and current status of the safety culture and standards in the major case study organisation. This, with performance measures, sets the level for which future improvement in gauged against.

Chapter 6 is the most significant phase of research for this thesis. It uses an action research methodology to apply knowledge management principles to safety management through a series of practical applications. These are integrated into the safety knowledge framework that was developed.

Chapter 7 is the second climate survey used to measure the level of improvement in the safety culture and provides objective evidence for the research question.

Chapter 8 is a detailed discussion of the complete study and results that underpin the conclusions and findings of this study.

Chapter 9 is a summary of the conclusions and findings of the study and provides areas for future research and development.

1.11 Summary of Chapter 1

This chapter provides an introduction to the topic being researched, and the overall research questions. It explained why safety is so important; legally, financially and morally. It described briefly that the legislative approach has produced improvement but is not producing an injury free workplace. The scope of the research was provided to place the context and background of the study. The contribution of the study to the field was provided as well as the significance to the broader community and the particular organisation studied. The knowledge management was introduced and in particular where the current research or approach is lacking in terms of safety management. Reasons were provided as to why one should apply knowledge management to safety. The research methodology was introduced in terms of the overall research design and data analysis involving both qualitative and quantitative techniques using methodical triangulation. Finally, the assumptions, limitations and delimitations were presented as well as the structure of this thesis. The next chapter goes into a detailed literature review of the two topics (safety management and knowledge management) and then reviews relevant research that has been conducted combining the two topics.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature in the disciplines of knowledge management and safety management. Because of the multidisciplinary aspects of this review, it is first necessary to examine both disciplines in their own right and then to examine how knowledge management principles are applied to safety.

Safety management has been in existence for many years, even decades. Frank and Lilian Gilbreth (1916) at the turn of the 20th century identified the importance of the welfare of the worker. Knowledge management gained popularity in the early 1990's (Nicolini et. al. 2003). Both topics have similar origins in the industrial revolution and Taylorism (Waring, 1991), however there is limited modern literature that links the two disciplines specifically.

The purpose of this study is to examine how safety can be improved by the application of knowledge management principles. Section 2.2 defines safety management and what it is, as it can have a very broad scope and covers areas such as health sciences, scientific measurement and environment, injury management and wellbeing through to the more traditional aspects of the physical workplace safety; machinery, training and risk management. Section 2.2 goes into more detail of the specific aspects of safety management and their context. Section 2.3 examines the literature associated with knowledge management in terms of definition and scope, because again, knowledge management can be difficult to define. Section 2.3.2 reviews the literature associated with several knowledge management principles. Section 2.4 then examines the available literature on the application of knowledge management principles to safety specifically.

2.2 Safety Management

2.2.1 Safety Management, definition and purpose

Safety management can be defined in terms of its purpose which is:

"to have a workplace free of injury and disease to ensure people leave work in the same physical condition for which they arrived (NOHSC, 2002: 12)."

To work safely in order to achieve this purpose requires a philosophy of continuous improvement, very similar to the quality movement of Deming and Juran (Deming, 1986; Juran, 1989), however the difference is the application of a risk management framework to achieve this. Fundamentally, Safety or Occupational Health and Safety (these terms are used interchangeably) ensure that people preserve their livelihoods that they have been accustomed to. This leads to a broader definition of safety as proposed by Erickson (1996:42):

"*safety denotes concern for physical injuries that might be experienced by the worker, such as cuts, abrasions, burns and crushing; health for those physiological injuries that are typically associated with illness and debilitation caused by exposure to chemicals or infectious agents, welfare for a range of psychological conditions, including stress which may derive from exacerbated workplace conditions.*"

Blewett and Shaw (1997) takes a more strategic view by saying "best practice" companies recognise that OHS can contribute actively to improvements in morale, productivity and in the bottom line. OHS in these companies is regarded as a benefit, not a cost. They also noted that it is up to the occupational health and safety practitioners to play a key role in the safety profession:

"to make it known to those in power in our enterprises that OHS is of fundamental importance to the health not only of employees, but also to the long term health of the enterprise. It is up to us to share information, to share knowledge and to influence decision makers in enterprises to put the spotlight on OHS" (Blewett & Shaw, 1997:76).

Wikipedia (2014) defines safety management simply as:

"... the reduction of risk to a level that is as low as is reasonably practicable."

There are many ways in which one can study the discipline of safety, however there are several core principles that must be understood which is explored in section 2.2.3. First the history and progress of safety management is examined.

2.2.2 Safety Management history and progress

Safety has evolved as the workplace and society has changed. Safety came into effect through the industrial revolution as workers moved from agriculture and trades to more complex high energy situations with the aid of machinery. This led to safety being focused on the people/machine interaction with machine guarding etc. Workers were moved into more repetitive jobs, resulting in more strain injuries, however robotics and automation have reduced a lot of the manual handling. Over the past two to three decades, work has shifted more towards an office environment with the age of computers, resulting in less physical activity leading to unhealthy bodies and stress related problems. This is a very brief overview, as indeed, many industries still exist through-out this spectrum of work activity from full automation and high computer usage through to manual handling.

Ted Emmett (in Mayhew et. al., 1999) describes the evolution of safety policy and programs in three phases:

1. <1985 Classical phase – state based regulations, factory inspections used for enforcement of safety law and prescriptive experts used for specific requirements, prescriptive legislation.
2. 1985-1991 Modern traditional phase – Non-prescriptive, performance based legislation (Robens style, HMSO, 1972) introduced with much broader responsibilities placed on employers.
3. >1991 Performance phase – local development focus of safety legislation and enforcement based on performance and facilitation in cooperation with unions, employees and enforcement agencies.

2.2.3 Safety Management Principles

Once it is understood what safety management and its purpose is, it is important to then examine the principles of safety management. That is, to identify the key topic areas that form the safety management discipline.

There are many aspects of safety and it is a very diverse field. It is necessary to distinguish between core principles that drive a safety program and specialist areas. This is reflected by many safety professionals and authors such as Erickson (1996:34):

*"In order to achieve an appropriately balanced conceptual and practical treatment of the many aspects of contemporary Occupational Health and Safety, …, a broad overview of the field [*as identified in the previous chapter]*, …, implementation of various types of programs for ensuring corporate compliance with selected health and safety regulations* [these core principles to follow]*, …, and specialist issues that extent well beyond the jurisdictional interests of any individual regulation and typically require a comprehensive appreciation, …, developing issues in science, technology and business management* [specialists areas covered later]."

With respect to the core principals, there also can be a wide range of topics and areas to cover. With respect to this study, the broad structure of the Australian Standard for safety, AS/NZS 4801:2001 (see chapter 4, section 4.3.1) was used as a starting point, then modified as appropriate for more practical application and the full scope of safety as defined earlier. For example, 'Health and wellbeing' and 'Injury management' are not covered in the standard, however Health may indeed be a precursor to safety, this is agreed to by various authors (Quinlan, Bohle & Lamm, 2010; Hofmann, Jacobs & Landy, 1995; Hofmann & Morgeson; 1999, Hofmann & Stetzer 1996; Quick & Tetrick, 2002) who started research in safety and ended in "Health and Safety".

The scope of this study on safety management can be defined in 16 core principles (as developed in chapter 6, section 6.2) and six specialist areas.
The core principles (later to be referred to as practical applications) are:

1. Safety legislation and regulations
2. Safety leadership and culture

3. Safety strategy and action plans
4. Risk management
5. Safety systems (minimum standards)
6. Safety communication and consultation
7. Behaviour based safety
8. Work environment (hygiene and monitoring, asbestos and legionella)
9. Injury notification
10. Incident/Accident investigation
11. Safety training
12. Safety auditing and compliance
13. Safety measurement and statistics (scorecard)
14. Injury management
15. Health and wellbeing
16. Off-the-job health and safety

The six specialist areas are:

1. Machine guarding
2. Mobile Plant
3. Chemical management and Material Safety Data Sheets (MSDS)
4. Personal Protective Equipment
5. Changing work patterns, shift and fatigue
6. Industry specific: Mining, Construction, Transport etc.

The 16 core principles form the basis of the practical applications as defined in the research design. Although the six specialists areas are covered in the literature review (and there are many more), they are not covered specifically in the practical applications but rather integrated into the core principles. For example, machine guarding is covered in several pieces of literature hence it needed to be individually examined in terms of the literature. However, in terms of practical application, it applies to the legislation of plant regulations and is a part of the physical work environment and issues should be treated with a risk management approach, hence it is integrated into a number of practical applications as part of this research.

Also upon considering these core principles and the logic provided, a strong practical emphasis is placed in this thesis, which is the reason why the practical applications are aligned with this literature in terms of content.

2.2.3.1 Safety Legislation and Regulations

Legislative frameworks and conditions exist all around the world in various forms. Occupational Health and Safety Acts exist in every state and territory of Australia and these are legislated and enforced through active prosecutions to ensure "a workplace free from hazard and harm to the health and safety of workers as far as is reasonably practical" (Occupational Health and Safety Act, Victoria, 2004). The Occupational Health and Safety Act of 1970 in the United States, which is the congressional authority of OSHA requires "that every employer covered under the Act furnish to his employees employment and a place of employment which is free from risks that are causing or are likely to cause death or serious physical harm to his employees" (29 CFR 1903.1(CFR, 2008)). The European Union, since 1973, has increasingly focused on the rights of citizens to a healthful and safe environment. However, many people would be surprised to know that such legislation also exists broadly in countries such as India, even more so as it is within a constitution means, where the Supreme Court in 1983 interpreted the "constitutionally guaranteed right to life as requiring a healthy and safe environment". In South Africa, the elected democratic government included in its constitution the right of every citizen (including workers) to an environment that is not detrimental to health and well-being (Erickson, 1996). This shows the broad international mandate, legislatively, on behalf of human health and safety of workers.

There is more legislation and regulation being developed for safety in many countries around the world. However the emphasis in Australia has moved from a prescriptive approach to a Robens' (A committee set up to examine the state of occupational health and safety in Britain and whose report from July 1972 became the precursor to many modern day legislation, HMSO, 1972) style risk management approach, which has advantages and disadvantages when applied to the workplace. The advantage of this approach is that the legislation can be adapted to suit a particular workplace and circumstances, the disadvantage is that there is not a definitive right and wrong answer which can be open to interpretation and creates a more complex legal argument as the following explains (CCH, 2001:5).

"In the late 1960's legislation in Australia was based solely on the specification of standards. A realisation that this type of legislation did not, in fact, lead to a safer workplace has led to the introduction of a different style of legislation. Impetus for the new style of legislation came from the Robens Inquiry into Safety and Health at Work, in 1972 (HMSO, 1972). The new legislation should be based on the expression of general duties of care and provisions for the participation of employees, coupled with better administration and inspection of health and safety. Between 1972-1989 all the Australian States and Territories introduced this style of legislation."

However, there is still a vast amount of prescriptive and non-prescriptive legislation in Australia (see section 6.2.1, Chapter 6). This is typical of other overseas jurisdictions in the Western world and results in most companies being compliance oriented. Veltri (1991) reports that 77% of companies he surveyed focused on regulatory compliance and traditional safety inspections, and strove for minimal safety investment. In these companies he found that the objective was to avoid problems, not to avoid accidents or promote safety. Only 7% of the companies surveyed desired to elevate their safety management programs to a level of excellence. This again shows that although safety legislation plays a key role in safety management and performance, it should not be the driver. Hence, a fundamental argument explored in this thesis is that knowledge management can be a better driver for safety improvement than legislation and other popular techniques. Hansen (1993) supports this argument and points to the failings of most safety management programs as referenced in Vetri's (1991) work. Hansen describes many traditional safety program elements (as covered in legislation and voluntary guidelines) that were found to not correlate with safety effectiveness and results in terms of safety incidents. The factors that were found to correlate with better incident statistics were management and cultural factors (Biggs et al., 2013). This is explored in more detail in the next section.

2.2.3.2 Safety leadership and culture

Many researchers and professionals agree that management commitment though leadership, consultation and company-wide involvement is critical to improving safety (Biggs et al., 2013; Erickson, 1996; Hansen, 1993; Hofmann et al., 1995; Roughton & Mercurio, 2002; Weinstein, 1997). Managers need to be committed to safety by showing it is a high priority and lower

other objectives such as efficiency in the short-and-medium-term for safety to gain a longer-term benefit as identified by Dedobbeleer and Boland (Dedobbeleer & Boland, 1996:4):

"*Risk perception shown in characterising safety climate show:*

Workers perceptions of management commitment.

Workers involvement and control, including their perceptions of risk."

Leading CEOs also identify safety leadership as a critical factor. For example, Rick Woods, CEO of Swire Cold Storage, first strengthened safety performance by establishing an Health, Safety and Environment (HSE) executive, reporting directly to him. The leadership of the HSE executive had taken safety focus to the next level of performance in this company (Australian Logistics Council *'Cool thinking on safety'*, 2008).

Without management commitment and leadership the safety culture will deteriorate and injuries increase as well as other adverse factors such as morale. Management should show commitment through involvement in day-to-day safety activities and not just through 'lip service' to drive the culture. Culture in a broader sense is described by Ritchie & Herscovitch (1995:471):

"Culture within an organisation is more than just the ethnic background of the work force (although this is very important). It is also about the shared values, beliefs and norms of the enterprise. These are often expressed in and supported by the myths, symbols and rituals of organisational life."

Weinstein (1997:34) identifies safety in terms of environment and networks:

"In any organisation the culture is determined by the business environment, the values, the heroes, the rites and rituals and the cultural network."

With respect to accountability, Dekker (2012) suggests that as organisations develop clear arrangement about who is accountable, the more predictable are the consequences of an occurrence.

In terms of a good 'safety' culture, it is one where safety is a part of the business and how it operates, where safety is a very high priority for everyone in the organisation. Every person is involved in safety actions and activities. It is a proactive approach to safety where safety issues

are raised before accidents occur and everyone collaborates to obtain a better way of working safely. This is supported by a number of authors:

"In an organisation with a strong safety culture:

Executives and managers visibly support safety, with no contradictory decisions and full accountability.

Employees are involved with safety and their views are sought and acted on.

Supervisors' actions support safety including recognising and appreciating safe work practices and behaviours" (Peterson, 1996:6)

"OHS culture is also revealed and reinforced in the stories told about OHS in an enterprise."
Blewett and Shaw (1997:44)

"When we talk about creating a safety culture, we usually are referring to creating an environment in which people do their tasks safely and for the right reasons."(McSween, 1995:35)

However, the safety leadership and culture can very quickly lose its credibility and impact if it is not followed through by action as discussed in the next section.

2.2.3.3 Safety strategy and action plans

Creating a safety culture takes time and years to develop - see practical application on safety strategy and action plans in Figure 6.1 for an example of a five year program. This is supported by other authors as well. For example Roughton and Mercurio (2002:74) states:

"Creating a safety culture takes time. It is frequently a multi-year process. A series of continuous process improvement steps can be followed to create a safety culture."

Narus (1989:124) also takes this long range view to developing a safety culture:

"This planning horizon is usually three to five years ahead. This is the time that reasonable resource, design, and implementation commitment can be made and relied on."

The safety strategy is the formal representation of this multi-year process and the steps within it. The strategy gives the overall direction, vision and goal of the organisation with respect to safety. The strategy should then be implemented through action plans. This ensures

commitment and dedication with continuing safety education and training, and safety improvements planned and budgeted (Hendershot, 2012; Weinstein, 1997). Action plans can serve as a road map to move a safety program from where it is currently to where it should be (see figure 6.2). An action plan defines what steps should be taken and the order in which tasks should be performed, and identifies who is responsible for completing each task (Hansen, 1993). Action plans are critical to the implementation of any safety program and improvement and need to be regularly communicated and reviewed. Action plans ensure that all employees see progress and the ongoing commitment by management in resources and spending. However, one can get caught up in action plans if these are not prioritised to achieve the greatest impact and improvement in safety, given that all organisations have limited resources. This is where risk analysis and the "hierarchy of controls" approach play a critical part and is the back bone of any successful safety program.

2.2.3.4 Risk Analysis and hierarchy

Risk management is strongly entrenched in safety legislation through many jurisdictions, for example in Victoria, Australia, the Occupational Health and Safety (Plant) Regulations 1995 require employers to ensure that:

- all hazards (potential to cause injury or illness) associated with the installation, commissioning, erection, operation, inspection, maintenance, repair, service and cleaning of plant and associated systems of work are identified;
- an assessment is made to determine whether there is any risk (likelihood of injury or illness) associated with the identified hazards; and
- any risk is eliminated, or if that is not practicable, reduced so far as is practicable.

The origins of risk management was first introduced into safety by Robens (HMSO, 1972), as noted earlier. There is considerable debate in safety arenas about the level of risk and acceptable risk and equally the most appropriate way to evaluate that risk. Jones (2005:17) supports a social rather than scientific view point:

"I support the use of a basic risk matrix as it includes only two elements – the chance of something happening and the possible effect it could have. These elements result in a risk level of, usually, high, medium or low. Any more than three elements complicate the process

unnecessarily. … To make a decision about the most appropriate risk control measure does not require scientific evaluation; it requires diplomacy and negotiation to arrive at a consensus decision that will achieve two things – an improvement in safety and industrial harmony."

Whereas Cowley (2005:4) explains more from a personal, simplistic view and a concern over too much analysis resulting in irrational outcomes:

"The risk debate included reference to a constant preoccupation with the presence of hazards and associated risks, caution 'slippery floor when wet'. We expect hazards to be clearly signposted and so once they are not, we are immediately exposed – in the 'slippery floor' example we look for the sign not for the water on the floor. I recently notice a cautionary sign in a workplace; "Beware of opening door". On leaving the workplace I bought a take-away cup of tea that was supplied with the cautionary label, "Contents may be hot". HSE identify that we may lose the concept of personal responsibility and reduce levels of protection as a results. I suspect the proliferation of warnings and over reaction to risk, subjects the OHS Profession to ridicule."

Our acceptance of risk can be associated with our knowledge of a provided situation, see section 4.2.3, a case study on carcinogenic substances. However, risks associated with safety need to be analysed to develop controls to reduce known risks to an acceptable level. This level can change as standards and practices improve. The reduction and control of risks is done through the risk control hierarchy (Manuele, 2013; Glendon & McKenna, 1995):

Eliminate – the risk by removing the risk.

Eg. Use mobile plant to lift, not people.

Substitute – for a lessor risk.

Eg. Replace acid for cleaning with common household detergent.

Engineering out – the risk is reduced by engineering controls.

Eg. Machine guarding.

Administrative - reduce the risk by better practices.

Eg. A procedure reminding people to bend their knees to lift objects.

Personal Protective Equipment (PPE) – to isolate the body from the risk.

Eg. Safety glasses or gloves.

2.2.3.5 Safety Standards

International Safety Standards such as BS 18004:2008; BIP 3094:2013; AS/NZS 4801:2001; Safetymap, 2009, (www.worksafe.vic.gov.au) and the National Safety Council of Australia (NSCA) 5 Star (NSCA 5 Star, 2009) (www.nsca.org.au) all have many elements and questions which can be used as a criteria for the development and improvement of a system and it is implied this creates safety improvement and a good safety culture. However, this is not always the case. An example in this respect is the Esso Longford disaster in Victoria Australia, where the company had passed a major safety system audit weeks before the disaster which killed two people (Hopkins, 2000). As noted earlier, Hansen (1993) reviews the failings of most safety management programs:

- Most companies are compliance oriented, with the objective to avoid problems, not to avoid accidents and promote safety.
- Many traditional safety program elements that were found to not correlate with safety effectiveness and results in terms of safety incidents.
- Top down management where management makes all decisions, establishes the rules and is responsible for making changes when necessary. It is not a cooperative approach and does not engender ownership.
- Another failure is that systems are designed around the premise that accidents are the result of unsafe employee acts and behaviours, and argues the emphasis should be on flawed management values, decisions and practices.

Hansen goes on further to recommend the following solutions:

- Finding and fixing basic organisational problems if accident rates are high,
- Correcting poor management attitudes, recognising that management is responsible for 94% of the organisational outcomes (including accidents),
- Not relying on rote obedience to safety rules which can never address all the hazards of a dynamic organisation,
- Addressing safety problems by careful up-front planning rather than after the fact inspection and
- Promoting accident analyses that look for the real causes of accidents.

Despite Hansen's (1993) views, a safety system does provide the framework and structure, however it still needs support, commitment and other non-tangible aspects to make it work.

Hansen promotes these aspects through a "Safety Management Revolution" (Figure 2.1), from 'Swamp' to 'the Norm' to 'World Class', with little emphasis on a safety management system.

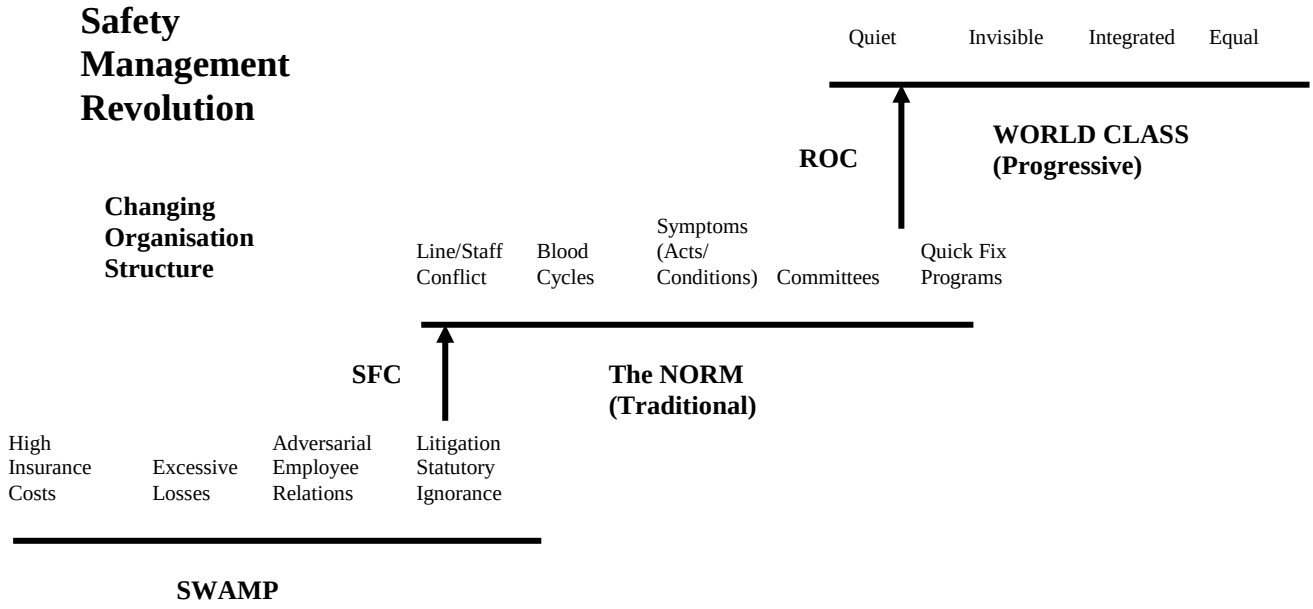


Figure 2.1 Safety Management Revolution (Source: Hansen, 1993)

A system is an established arrangement of components that work together to attain a certain objective, to prevent injuries and illnesses. All elements of a safety system are like a puzzle and all are interrelated, this forms part of the systems thinking as identified by Leveson (2011). It is only as effective as the weakest link, a flaw in one aspect will affect others (Roughton & Mercurio, 2002). The greater the number of relevant factors which are accounted for in a particular approach to the safety management system, the more likely it is that it will be effective in a sustained way (Waring, 1996). Even despite a good safety system, as the Esso Longford disaster noted earlier demonstrates, management systems need to be appropriate and suitable to ensure local ownership and empowerment. An integrated management system helps to provide this, in that safety becomes part of work, not an extra task or activity, as Blewett and Shaw (1997:5) states:

"A best practice approach specifically incorporates Occupational Health and Safety at each step, not as a checklist at the end."

This common understanding and approach is often articulated in safety circles through employee consultation which is discussed in more detail in the next section.

2.2.3.6 Employee Consultation

The modern approach to OHS places an emphasis on consultation between employers and employees and can also been seen as a critical component of the management of risks (Granerud & Rocha 2011). Employee consultation is seen as a common approach in which everyone is involved in the safety solution and to ensure that all employees take ownership in safety as noted by the following passage, taken from the Worksafe Victoria web site (www.worksafe.vic.gov.au: 2011):

"Involving workers in health and safety will have benefits in terms of both the information that will be available to the health and safety program and the commitment of the workers to the program".

Consultation has become more and more apparent in updates to legislation, with whole sections dedicated to employee consultation and engagement arrangements, such as safety committees. (Occupational Health and Safety Act, Victoria, 2004). There are many studies conducted into employee consultation and empowerment, particularly in safety. Roughton and Mercurio (2002:116) give a good summary:

- Employees are the individuals most in contact with potential safety hazards.
- They have a vested interest in an effective management system that supports safety.
- Group decisions have the advantage of the group's wider range of experience.
- Employees are more likely to support and use programs that they have input into.
- Employees who are encouraged to offer their ideas and whose contributions are taken seriously are more satisfied and productive on the job.

One of the key findings of the famous Hawthorne studies (Sutton and Rafaeli, 1987:43) with respect to safety culture was

"... employees ... being involved in activities and providing input to management".

The Robens' committee handed the following recommendation (HMSO, 1972:32):

"Most of the employers, inspectors, trade unionists and others with whom we discussed the subject are in no doubt about the importance of bringing workpeople more directly into the

actual work of self-inspection and self-regulation by the individual firm. There is no real dispute about these aims. We are left with the question – can legislation help, and if so how?
We believe that the best answer would be a statutory requirement dealing in general terms with arrangements for participation by employees. Our view is that the involvement of employees of safety and health measures is too important for new occupational safety legislation to remain entirely silent on the matter.
We recommend, therefore, that there should be a statutory duty on every employer to consult with his employees or their representatives at the workplace on measures for promoting safety and health at work, and to provide arrangements for the participation of employees in the development of such measures. The form and manner of such consultation and participation would not be specified in detail, so as to provide the flexibility needed to suit a wide variety of particular circumstances and to avoid prejudicing satisfactory existing arrangements."

Despite all the legislation that is now in place in Australia based on the Robens' Report (HMSO, 1972), Berger (2005) argues that there are still some basic communication issues which need to be addressed, one way of doing this is through a behaviour based safety program.

2.2.3.7 Behaviour Based Safety

Behaviour based safety is the modern evolution of safety, as it is found in some studies that over 87% of incidents could have been prevented by a change in behaviour (Granerud, 2011; McSween, 1995). In his study McSween found that DuPont's accidents occurred due to unsafe acts rather than unsafe conditions supporting an earlier study which found the number to be 88%. Behaviour is part of the social aspect of safety, the best systems in the world cannot overcome bad or poor safety behaviour. But what is behaviour-based safety? A working definition is provided by Krause, Hidley and Hodson (1990:186):
"Behaviour-based safety is an approach which focuses on observable, measurable actions critical to safety. These critical work-related skills are discovered by applied behavioural analysis of data, including incident reports. Then processes are put in place that reinforce positive behaviours through a blame-free, no fault, approach to behavioural and accident analysis, observation and communication."

The basis for safety improvement using behaviour-based safety is that unsafe behaviours are the final common pathways of 80-95% of all accidents. They are the mass of pre-existing behaviours that will certainly lead to accidents. Decreasing the number and frequency of unsafe behaviours will certainly lead to immediate decreases in incident rates (Weinstein, 1997).

The key components of Behaviour Based Safety are (McSween, 1995:4):

1. A behavioural observation and feedback process.
2. Formal review and evaluation of data.
3. Improvement goals.
4. Recognition of improvement and goal attainment.

It is important to acknowledge the efforts of individuals and their contribution to the behaviour-based process, hence measures are important. Geller (1996) identifies typical measures of success: numbers of behaviour observations, percentage of employees volunteered to be observed, number of coaching sessions per week, and the percentage of safe behaviours per critical behaviour category or work area. A good working model of this behaviour based safety approach is provided in section 6.3.7. However, a behaviour-based safety approach can be flawed if the fundamental working environment is very poor, as the next section of the literature review explains.

2.2.3.8 Work Environment

When considering the work environment, the scope can be very broad. Hence, with respect to this study, this needs to be limited. Erickson (1996:4) gives a very broad definition of safety and how it relates to the environment,

"... the holistic appreciation of worker safety is inclusive not only of the physical, physiological, and psychological dimensions of the human being, and not only of direct workplace exposure to hazards, but also of environmental exposures that occur outside of the workplace."

However, for the purpose of this research work, environment will be considered principally in the context of immediate work environment in terms of physical environment and the conditions of it, such as air quality. If terms of physical work environment, there are many aspects which can be considered such as: vehicles/mobile plant, noise, lighting, emergency

services, machine guarding, ergonomics, electrical, chemicals, material handling, personal protection, temperature and thermal comfort, atmospheric, heights.

The work environment often forms part of the "visible" safety program, it is what employees sees and helps to drive an improved safety performance and culture. A visible safety program helps set the stage for improved employee attitude (Roughton & Mercurio, 2002). This visible safety of the physical work environment is critical to overall safety program and improvement as explained by Yossie Berger of the Australian Workers' Union (OHS Unit), "The best changes come from attending to small daily risks and hazards and fixing them first" (Berger, 2006:10). Many of the practical applications presented in Chapter 6 start with the changes in the physical work-place and have a flow-on effect of safety improvement from this.

Hygiene and monitoring has come into effect in the work environment because of the effects of the chemicals used to manufacture products having both immediate and long-term effects on the human body.
"However in Australia's workplaces today the presence of thousands of hazardous substances for which minimal health related information is known, and the likely substandard exposure controls in many workplaces, suggest that there is still much cause for concern" (Mayhew & Peterson, 1999:35).

Monitoring and hygiene is used to reduce the risks associated with working with chemicals, the risks are still present whilst humans need to come in contact with chemicals in its various forms. However, the aim is to minimize the risks to an acceptable level, that is, a level where the chemical will never affect the persons' livelihood. It is a specialised area and often specialists are used because of the complex medical implications, this is beyond the scope of this study.

Often work environment issues can become very political, particularly when they can be associated with serious consequences (See the case study in section 4.2.3). Asbestos can be very dangerous due to the long-term effects, which has killed many people. Legionella is also a recently raised issue due to some serious illnesses from the bacteria. These represent very emotive issues and although they can be addressed through technical means, they also need to be addressed by considering peoples' emotions and fears, this is the basis of the writings by Berger (2006). Emotions can also arise through serious accidents in the workplace and

extensive efforts need to be taken to address these. The more physiological and psychological aspects of safety for serious injuries and the great trauma that results from them (Resick, 2014). First, it is necessary to explore aspects of injury notification which can lead to work environment improvements.

2.2.3.9 Injury Notification

Injury notification is an important core principal of safety, however there is little coverage in the literature as it tends to be specific to the legislation of the jurisdictional area for which the advice resides. Often injury notification is referred to in terms of computer systems for recording injuries or incident response. Erickson refers to injury notification in this manner when describing an incident response,

"Incident response: Description of individual health and safety incidents, with detailed assessment of cause and cross-reference to pertinent regulatory requirements, corporate policies," (Erickson, 1996:256).

However Erickson does not explain how this is achieved and maintained in practice, such as when legislative changes occur. Colvin (1992:70) talks more about responsibility rather than record keeping:

"Responsibility for accident reporting and investigation should remain as close to the scene as possible, i.e. responsibility should rest with the supervisor(s) of an employee injured in an accident or with the location manager at the site of the accident."

Erickson also recognises that there may be a knowledge gap and suggests that a task-force should be appointed depending on the severity of the incident (Colvin, 1992). Akass (1994:45) puts a strong emphasis on injury notification or accident reporting:

"No employer should question the importance of accident reporting, even if an accident results only in a minor injury – or no injury at all.", …, he goes on further to link reporting to the consequences and losses due to accidents, .., *"accident intelligence ought to be as much a part of the information flow as the state of the order-book, cash flow, and all the other elements of business life."*

Figure 2.2, on the next page, illustrates the potential of accidents to affect a business in an adverse and unwanted manner. When an injury occurs, often only the direct costs are identified

and considered such as the impact on Workcover premium or wages of the injured employee. However, the indirect costs can be much greater, up to nine times this amount, as identified in the accident iceberg by Heinrich (1941). Financial costs such as higher absenteeism, claims processing of staff and management, reduced productivity and replacement labour costs. The non-financial costs are hard to measure but can be even more significant. These include the reputation of the company which has a bad injury or fatality, the loss of skills and knowledge of the worker that is no longer at work, morale and motivation of the workforce affected by the incident and loss of a fellow employee, both short-term and long-term. Above all, the permanent impact of the injured person's life as a result of an injury or the family left behind from the deceased employee who died at work.

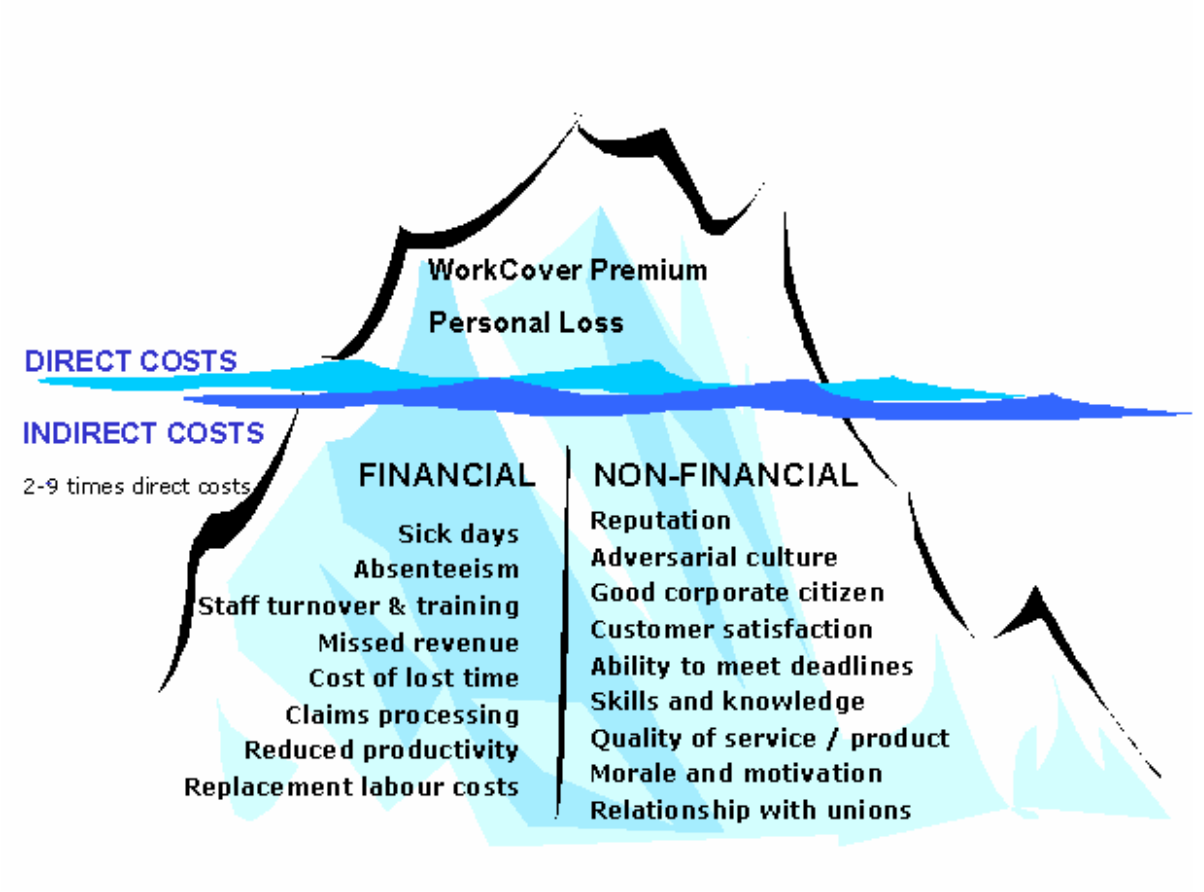


Figure 2.2: Accident Iceberg (Source: Heinrich, 1941)

Hence, many authors support the view of injury notification but little go into the specific mechanics of how to implement it effectively in practice. The practical application in chapter 6.3.9 covers this in more detail. However, once the record is obtained, the accident/incident investigation is then equally, if not, more important to minimize the potential losses in the future, this is covered in the next section.

2.2.3.10 Incident/Accident investigation

Accidents are being replaced by incidents which is a broader definition covering non-injuries as well. The English Oxford dictionary (Soanes, 2004:37) defines an "accident" as:
"anything that happens unexpectedly, without design, or by chance".

This definition does not help with an investigation to find the cause and prevent it from happening again. An incident in this dictionary is defined as:
"something that has occurred in connection with something else".

The American OSH Administration (OSHA web site, www.osha.gov, 2009) states an:
"incident investigation is the process of identifying the underlying causes of incidents and implementing steps to prevent similar events from occurring. The intent of an incident investigation is for employers to learn from past experiences and thus avoid repeating past mistakes".

There are many different approaches and techniques for investigations but they all aim principally to achieve that outcome.

Accident analyses are conducted not to find fault but to find facts. These can: determine direct causes, uncover indirect cause, prevent similar accidents, document facts, infer on costs, promote safety measures and standards. As Colvin (1992:71) explains in the following simple example:
"If an employee is injured because he/she failed to wear safety glasses, who is responsible? The employee? The supervisor or manager? No. The system failed: failed to train the employee properly in the value of eye protection, failed to develop a positive safety attitude so that the employee wanted to wear eye protection, and failed to create a work environment that encouraged the wearing of Personal Protective Equipment (PPE) as a good work habit."

Incidents should begin to be investigated immediately to ensure accurate details and to preserve evidence. One should examine human, situational and environmental causes in order to ensure a complete set of actions (Weinstein, 1997).

One needs to consider the much broader work environment and systems when carrying out an investigation, rather than the immediate incident and outcomes, this is demonstrated in the 'ASET' Process by Krause and Finley (1993:11).

1. Atmosphere – Vision, Values, Common goals.
2. Systems – Training, policy, maintenance, Information Technology and knowledge.
3. Exposure – State of equipment, workplace conditions, behaviour.
4. Target – Incidents, near misses.

Although many organisations have incident investigation procedures that have been in place for a long time, Dell (2003:23) explains that in most organisations little effort is expended to ensure the standard of accident investigations. Dell recommends that as a minimum OHS investigation guidelines need to address:

1. Preparation for an investigation
2. Immediate response actions
3. Protection and preservation of evidence
4. Accident photography
5. Witnesses and interviews
6. Establishing all the facts
7. Analysis and testing
8. Accounting for all possible causation scenarios
9. Determination of corrective actions
10. Development of focused recommendations
11. Standard investigation reports and report preparation
12. Investigation closeout, review and quality assurance.
13. The applied use of accident models
14. The conduct of risk assessments as part of investigations
15. The role and utilisation of the specialist investigations.

However, all these aspects create an arduous task for any professional charged with the investigation, so the question becomes what level of investigation should be carried out for what type of incident or consequence. This can be addressed by some broad company guidelines, such as, all medical and lost time injuries investigated and the skill and knowledge of those involved in the investigation. The level of knowledge and quality of incident

investigation is largely determined by the skills of the person (Dien, 2012) and the safety training that is carried out which is introduced in the next section.

2.2.3.11 Safety Training

Training is the basis by which safety responsibility and ownership can be transferred to the individual. *"Give appropriate training and access to knowledge and resources, teams can determine how to improve OHS in their areas."* (Blewitt & Shaw, 1997:3) Some professionals argue training can prevent all accidents: *"had adequate training been in place the chain of events would in all probability have been broken"* (Pybus, 1996:87). Training must be carried out in all aspects of safety as it relates to the task. This is enforced through legislation. It ensures the employees understand the risks they are exposed to and encourages them to use the controls put in place to protect them. However, many traditional instructional approaches do not always work, they fail to adequately prepare personnel for the required tasks and inadequately assess whether learning has occurred (Vinodkumar & Bhasi, 2010). The educational model is one which works better where specific tasks and skills are tailored to the organisation, providing greater ability to provide knowledge and skills to facilitate behaviour change (Clancy, 2006:34). The degree of training depends on the knowledge and skills of the employee and needs to be tailored accordingly. Comprehensive records and details of training need to be kept as legal evidence and for auditing purposes. Safety training is moving to Competency Based Training (CBT) to ensure employees are competent in safety tasks not just to provide evidence that training has been conducted but also to ensure the individual performs the intended tasks in practice. However, one of the biggest shortfalls in most training programs in organisations is that they are focused on regulatory compliance rather than health and safety objectives and requirements (Berger, 2005). In short, regulatory requirements are best viewed as the minimum requirements under any circumstances. To ensure workplace health and safety, it is typically necessary to go well beyond written law and do what is required in actual workplace circumstances to protect a worker, as noted previously and supported by many professionals and researchers alike, (Erickson, 1996:243; Roughton and Mercurio, 2002:266; Akass, 1994:73; Colvin, 1992:71). One way to obtain this evidence is through auditing and compliance.

2.2.3.12 Auditing and Compliance

There is great pressure on auditing (or inspections at the more basic level) and compliance by companies to prevent safety issues before they occur and is often implied or dictated in

legislation. Often an audit can be used by management to provide a level of defence against prosecution for negligence (Workcover NSW Vs Dasco Construction Pty. Ltd, Court Proceedings NSW, 2007). Authorities are placing greater pressure on companies to monitor their own performance and so the authority can then only investigate complaints and accidents. Audits and compliance should be applied at all levels and aspects of safety systems and programs.

Examples of different types of audits may be: housekeeping audits, workplace audits, emergency drills, legal compliance audits, certification and system audits, procedure and standards audits.

"A comprehensive program audit is essential periodically for the evaluation of the whole set of safety and health management means, methods, and processes, to ensure that they are adequate to protect against the potential work site hazards" (Weinstein, 1997:99).

Audits are designed to identify deficiencies and gaps to a standard that can then be used to derive corrective action for continuous improvement. One of the most important aspects of auditing is to ensure follow up and action.

"The quickest way to destroy your safety credibility is to ignore the recommendations by inspection (and audit) teams" (Colvin, 1992:97).

Another common flaw seen in auditing programs is the more superficial type monitoring of housekeeping etc. whereas the emphasis should be on examining the outcomes of audits to find the underlying causes and not just address the symptoms (Akass, 1994:32). It is beyond the scope of this study to go into further detail on the specifics of auditing, such as how to scope and conduct an audit, provide feedback and follow up audit team participants etc. More information can be found in Pain (2011); Akass (1994); Weinstein (1997); and Hofmann and Tetrick (2003) and in section 6.3.10. The next section examines how to monitor the performance of a safety management system.

2.2.3.13 Measurement and Statistics

Companies around the world judge their safety performance using statistics. Often the injury rates used are deaths, permanent injury, lost time injuries, medical treatment and first aid injuries. Definitions and details may vary, as Jones (2005:20) explains:

"Lagging indicators such as LTIFR (Lost Time Injury Frequency Rate) has undoubtedly been subject to much manipulation and misuse and, when used by themselves, are not of much use in measuring performance. Definitions for these are found in the Australian Standard 1885.1 – 1990 "Measurement of occupational health and safety performance" but this standard is largely useless in its present form since it allows the proverbial truck to be driven through the definitions. Its date shows that is has long been neglected, and sadly overdue for revision."

Andrew Hopkins (2001:15) a leading Australian author on safety also supports this view:
"The Moura experiences (where an underground explosion kills 11 workers) cast doubt on the often repeated claim that a good LTIFR indicates that safety is being well managed." And "…the danger is that a single-minded focus on reducing the LTIFR leads systematically to the neglect of catastrophic risk".

The problem is that these are lagging indicators, often when someone is injured it is too late. Leading indicators may also have their issues as Jones also explains that they too may also be useless unless they are measuring something that is specifically going to reduce losses, before they are chosen:
"the practitioner has to have a model in their mind of the overall system and how changes in inputs or processes have an effect on the outcome" (Jones, 2005:20).

More recent measures focus on positive performance indicators such as risk assessments, audits, incident investigations, safety actions, safety observations and training.

Krause, Hindley & Hudson (1990) discusses the use of accident rates as safety measures, observing that they must be used with caution. He notes that normal rates are low, apparent rate variation may often be statistically invalid. For example, a quarterly change from 0 to 4 injuries from a 100 man group that average 2 per year has no statistical significance. It also diminishes credibility of the entire safety program.

"By being reactive rather than proactive, cause management to over react to events, incentive programs push accident under reporting and mis-classification" (Krause et al., 1990:41).

He goes on further to state that:

"There is no way of telling where the problems are or of predicting what might happen if there is no action taken when the only measure of performance are outputs of incidents (Krause & Finley, 1993:11).

A balanced scorecard (Kaplan & Norton, 1996; Juglaret et; al., 2011) can be used as a way of introducing safety statistics and monitoring safety performance. The balanced scorecard model integrates both financial and non-financial metrics. It is a management tool that provided feedback on both internal business processes and external outcomes in order to continuously improve strategic performance and results. This is covered in more detail with respect to safety in the practical application presented in section 6.3.13.

Geller (1995) discusses more about the use of statistics and states that safety should be measured and displayed to the entire workforce in term of "achievements" with emphasis on processes that decreased injury rates. Achievements can be environmental (safer equipment, hazards corrected), personal (training, celebrations) or behavioural (observations and trending of work practices). Hence, whichever point of view is taken, safety statistics and performance measurement play a critical role in the improvement of health and safety performance but must be used with caution. One way to greatly improve safety performance is through improved management of the injuries that have occurred which is covered in the next section.

2.2.3.14 Injury Management

In reviewing the literature on injury management in the safety arena, there are few studies that examine this in any depth. It is as though injury management is in the realm of the medical providers and rehabilitation specialists. This is a real concern in terms of the knowledge, breadth and scope of a safety professional in that they may not recognise the full process of an injury or the consequence of poor safety. Hence, the following literature comes from a different area to typical safety texts and journal articles. The primary goals of injury management are to (Isernhagen, 1991):

1. Improve the productivity of individual workers and the work group.
2. Maintain the health and improve the safety of the worker in the workplace.

3. Decrease lost work time due to illness or injury.
4. Enhance return to work processes and minimize the likelihood of disability-induced retirement.

The focus on injury management with respect to this study is to understand how injury management impacts on safety. Hopkins (2001:265) argues that the focus needs to be on safety improvement rather than on injury management. However, he does recognise that injury management has a role to play and can produce a degree of improvement:

"… A company had recently appointed a OHS manager, she tackled one of the poor performing plants. She adopted a policy of challenging every claim and introducing a tighter injury management program, within two years the number of serious compensation claims had reduced by 70%. …"

Hopkins goes on further to explain that once the claims were under control to make further improvement, emphasis had to be placed on safety and reducing the injuries in the first place, such as introducing manual handling equipment. At this point, then, compensation pressures will begin to yield safety improvements, but only after the number of claims has been reduced as far as possible by a tighter approach to claims management. Hopkins goes even further to argue that one better way to improve workers compensation costs and reduce injuries through safety is through increased inspection. While individual worker factors such as gender, age, personality, ethnicity, and substance use do contribute to workplace injuries and fatalities; broader social and organizational workplace factors such as workload, work hours, work environment, safety culture and provision of quality supervision influence individual worker attitudes and behaviours in workplace injury and fatalities (Kumar, 2011). So, in summary, injury management does play a role in safety management, but there is a limit to its impact on safety improvement. However, once we start to consider all aspects of injury management we realise that the overall health and wellbeing of the person comes into play as a precursor to the impact of an injury as discussed in the next section.

2.2.3.15 Health and Wellbeing

There has been a considerable increase in the aspect of "Health" in Occupational Health and Safety, often the word is tagged onto safety without a full understanding of what it really means. There is also the actual definition of "occupational health" which is often concerned

with hygiene and measurement and chemicals which are covered separately (Weinstein, 1997). In this study, research on health and wellbeing is concerned with the workers' overall physical health not only to perform their job but also as their ability to live a healthy and productive lifestyle in or out of work. The World Health Organisation's (WHO) defines health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" (WHO, 1948:56). For many companies, increasing awareness of the importance of having a safe and healthy workforce has led to a variety of initiatives which would have been unheard of even thirty years ago. In addition to regular medical examinations, many organisations provide health and fitness classes, gymnasium and swimming pool subscriptions, health advisory services, including counselling on drugs and alcohol, smoking cessation and many other innovative approaches (Akass, 1994:264).

The demographic of the workforce is changing in Australia, at present for every six people working there is one retired person. By 2020, there will be only three people working for every retired person (Department of Health and Aging, 2009). Australia has an aging workforce and many of these people have not grown up with sufficient health emphasis and care of themselves. However, more importantly, evidence shows that the workforce is becoming less active and doing more sedimentary type jobs with the advent of computers. This is causing more and more health issues which sometimes is being translated into workplace injuries and issues (Department of Health and Aging, 2009). Hence, to properly address the complete safety of the workforce, programs need to also be put in place for employee health and wellbeing. Investing in employee's health produces dividends (Cowley, 2008). These could include increased productivity, lower medical and disability costs, reduced absenteeism and staff turnover and improved satisfaction and morale amongst employees (Murphy, 1984).

However, convincing organisations to spend a significant amount of money on employee health to produce meaningful results is no easy task (Harris & Spickett, 2011). Many managers still assume that action taken to benefit employee wellbeing is at the cost of organisational productivity or effectiveness (Hofmann & Tetrick, 2003:49). The recent concept of the 'healthy work organisation' challenges this assumption (Jaffee, 1995). According to this view, employee health and organisation health are interlinked rather than incompatible (Hart & Cooper, 2001:93). More information on this topic can be found in the practical application of

this topic in section 6.3.15. Health and wellbeing at work is closely linked to the overall health of the worker not just at work but also off-the-job.

2.2.3.16 Off-the-job health and safety

Off-the-job health and safety is another area not covered extensively in the literature. However, according to Colvin:

"Off-the-job safety is significant to the success of any safety program since traffic-related deaths and injuries at home account for a substantial number of impaired workers and major medical claims each year" (Colvin, 1992:191).

This is recognised in New Zealand where the government Accident Compensation Council (ACC) system covers injuries whether they occurred at home or work. This also helps to remove the disputes over where or when an injury occurred which often is raised with workers' compensation claims in Australia. Colvin goes on further to describe in more detail the components of an off-the-job health and safety program including prizes and promotions. He even states that examples should be included in training in areas that also include the home such as electrical, falls and chemical safety - this is supported by Lord et al. (2001). More information on this topic can be found in section 6.3.16. The review of the safety literature now moves into some of the specialist safety areas that require specific attention.

2.2.4 Specialist Areas of Occupational Health and Safety

The scope of specialist areas in safety could be endless depending on the area and field of study. Some not covered here include noise management, vibration analysis, asbestos, Legionella and ergonomics. Several areas are chosen here as a guide and referred to because of how often they are confronted by safety professionals. These include; Machine Guarding, Mobile Plant and Licensing, Chemical Management and Material Safety Data Sheets, Personal Protective Equipment and Changing Work Patterns, Shift and Fatigue. More information can be found in the relevant references on the topics discussed below. However, to provide an in-depth review of all areas is beyond the scope of this study. Each one in its own right could form a separate field of study.

2.2.4.1 Machine guarding

As noted earlier, automation and machines have become a large part of the manufacturing environment. Indeed, in many environments, such as mining and construction, human abilities

of strength, speed and repetition have been replaced by far superior automated machines. Starting with basic tasks such as lifting to more complex tasks such as assembly and automation has helped to improve safety enormously. However, many of the machines are not designed for the human but for the task (Ridley & Pierce, 2013). Hence, where the interaction occurs between human and machine, people can be injured, and because of the level of automation, speed and power, all too often, very serious injuries and fatalities can result. Engineering has provided many of the solutions, however, it comes down to practicality, inherent risk, state of knowledge and cost of mitigating the risk. The human-machine interface needs to take into account the human limitations; sense organs, interpretation, posture, layout, comfort, work rate, fatigue and stress (Glendon & McKenna, 1995). This is also supported by (Payne, 2007:42):

"Unfortunately there is still a cultural issue that if you are a qualified tradesman, you do not need guarding on lathes and drills. Tradesmen are often working long hours and can easily become tired when doing hazardous jobs on machines. Even the most competent tradesman needs to be protected from risks on the job."

The legislation relating to guarding is tending to be replaced with new legislation based on the risk management approach (CCH, 2001:168). Machine guarding needs a multi-disciplinary approach from basic risk management to in-depth design and analysis to specified standards such AS 4024, the Australian Standard for machine guarding. Once machinery, equipment, and process hazards have been identified, employees may still have to enter the "danger zone" whilst working on or near machinery. They must be protected or the hazard must be eliminated through securing the power and energy sources, for this a Lock out/Tag out (LOTO) standard or procedure needs to be implemented. This forms part of the whole risk management hierarchy noted earlier. Often multiple levels need to be introduced for high risks. More information can be found in the practical application in section 6.3.4.

2.2.4.2 Mobile plant and licensing

Mobile plant introduces a high risk to the work environment due to its force and mobility. Hence, there are strict controls around mobile plant including licensing. These standards are also continuously improving and being engineered into mobile plant at the design stage such as proximity sensors, stabilizers, visual aids and anti-skid braking. Because of the use of such equipment, regular maintenance and inspection programs are critical as is the license to operate the equipment safely (Saric et al., 2013). All workers should be instructed to report defective

equipment to their supervisors and to refuse to use any defective equipment, such as a forklift with a faulty warning horn (Colvin, 1992:157). The condition and maintenance of such critical equipment can be seen as a strong indicator of the safety management and leadership, like the suggestions from auditing programs noted earlier, see audit observations and results noted in the practical applications in section 6.3.12.

2.2.4.3 Chemical management and Material Safety Data Sheets

Chemicals can have all types of effects on the body, from immediate, such as burns by an acid, to a long-term deterioration of the human body such as chemical sensitivity. There is a statutory duty to provide users with adequate health and safety information about the product, whether it is an article, a piece of equipment or a substance (Waring, 1996). The Material Safety Data Sheet (MSDS) which is required by the producers or distributors of chemicals specifies all the known health information about a chemical which can be used to minimize risks. There is also a statutory duty for employers to ensure the safety requirements specified in the MSDS are implemented and maintained (Occupational Health and Safety Act, Victoria 2004). However, there is an issue with obtaining good, accurate information and adequate risk controls. One of the limitations of data sets is the adequacy of the reporting for chemical type incidents (MacFarlane, Smith & Keegel, 2013). There seems to be a lack of awareness on the part of employers, employees and the medical profession of the significance of occupational disease. In the community at large, there is less awareness of occupational diseases than there is for occupational injury (Cowley, 2003).

2.2.4.4 Personal Protective Equipment

Personal Protective Equipment (PPE) is often used to address safety issues however, it should only be seen as the last resort or as an added precaution (Janda et. al. 2013). Other controls such as guarding should be used in conjunction with PPE as it is on the lower end of the risk control hierarchy and not completely effective in reducing the risk of injury. There are many good references on PPE and what to check for, see Weinstein (1997) and Akass (1994) or one of many local government safety authorities. PPE is also improving in standards and design to allow for the many variations in human features and for added comfort. The limitations of PPE needs to be clearly understood, it is essentially a barrier between the person and the hazard as the last line of defence on the physical person (Colvin, 1992). There has to be close attention to the detail when using PPE as a safety control measure to ensure the correct type and usage

(Erickson, 1996:76). There are other significant limitations of PPE which need to be recognised (Roughton & Mercurio, 2002):

- PPE can be uncomfortable and place the person under additional stress, particularly in hot environments or during manual intensive tasks.
- Poorly fitted or incorrectly chosen, PPE can be particularly hazardous.
- Most of all, PPE relies on human behaviour and vigilance and requires consistent supervision.

"The PPE program should have strictly enforced rules that determine when to use PPE and what type to use. The PPE program should address responsibility, availability, fit and maintenance" (Weinstein, 1997: 136).

2.2.4.5 Changing work patterns, shifts and fatigue

The work environment is changing in manufacturing and other previously labour intensive industries with manual labour continually being replaced with automation (Belbin, 2013). This causes several changes in the work environment introducing its own safety risks (Hofmann & Tetrick, 2003):

- Change in skills to more mental ability related tasks, which can lead to stress.
- High capital outlay which means 24 hour operation creating more varied shift patterns.
- When a robot fails, the consequences can be more serious and immediate than manual labour.
- Less direct employees, so more issues with people working on their own.

However, industrial processes have not been the only force driving typical work arrangements. Demand for 24 hour availability of goods and services, globalisation and new technologies have also significantly contributed to the new demands on workers (Hofmann and Tetrick, 2003). There is no doubt that such work patterns can affect safety performance (Folkard, Akerstedt, Macdonald, Tucker & Spencer, 2000, Smith, Folkard, Tucker & Macdonald, 1998). One way to help reduce the negative effects of such irregular patterns of work, not in line with the usual body rhythms, is multi-skilling:

"Multi-skilling has, on occasion, been used as a euphemism for multi-tasking. In multi-tasking employees take on a larger number of tasks, each equally as repetitive as before. As well as

exacerbating existing manual handling, stress, fatigue and risk control overall" (Blewitt & Shaw, 1997:31).

Bradley (1989) examined companies with higher accident rates finding that if the work required the processing of more complex information and it was more varied that the reporting of injuries was less often and less time was allowed for preparation than those companies with low accident rates (Bradley, 1989:501). Any organisation should link flexibility to its goals and objectives and to its health, safety and wellbeing strategy. IBM's data demonstrates that workers with flexibility can work up to an additional day per week without experiencing work life conflict compared to workers who did not have flexibility (Edmondson & Roloff, 2009).

2.2.4.6 Industry specific OHS – Mining, Construction, Transport etc.

Many industries have their own specific standards and issues based on the inherent risk in the type of tasks that need to be performed. Some industries are a lot more dangerous than others and are often more highly regulated and controlled. For example, the Oil and Gas Industry has a high risk of explosion so it is heavily regulated in risks such as hot work (here hot work refers to excessively high temperature). The mining industry has explosion and underground issues. The construction industry has a high risk with respect to working at heights, particularly with multilevel constructions. The transport industry again has many of its own specific risks and issues, however, it is beyond the scope of this research to go into detail in these areas but is should be recognised that these risks exist and that they have their own specific hazards, issues, controls and legislative requirements. These legislative requirements are constantly changing such as the introduction of fatigue legislation for truck drivers nationally introduced in Australia (National Transport Commission, 2008). For more information on this area of safety, it is best to start with the relevant industry body or government web site.

2.3 Knowledge Management

The previous section defines the context and background on safety. This section reviews the literature on knowledge management. As with safety, one first needs to define what knowledge management is, and more importantly, what it means in the context of this study.

2.3.1 What is Knowledge Management?

Knowledge Management is a collective term for describing what people know in order to carry out a task (Davenport & Prusak, 2000). Knowledge Management is the management of that knowledge through the system and processes. Activity and mind are social in their content as well as in their origins: they are social activity and social mind (Marx & Engels, 1846). For the purpose of this study, Knowledge Management can be defined as social, information and economic:

Social

Organisational knowledge and learning cannot be conceived as mental processes residing in people's heads, they must be viewed as forms of social expertise. That is, knowledge is action situated in the historical, social and cultural contexts in which it arises and embodied in a variety of forms and media. Knowledge is negotiated and is dynamic (Nicolini, Cherardi & Yanow, 2003).

Information

From an information context, knowledge management is the link between raw information and high value-added information (Davenport, Delong & Beer, 1998).

"A set of significant information which constitutes true and justified belief and implies a technical competence" (Nonaka, Umemoto & Senoo, 1996:203).

Economic

Knowledge management is intellectual capital, quantified and estimated, accumulated and exchanged as a high value commodity (Nahapiet & Ghoshal, 1998, Stewart, 1994).

2.3.2 Why Knowledge Management?

Knowledge Management (KM) is important for a number of reasons. The global environment is constantly changing and products quickly become commodities, produced anywhere in the world. Hence, differentiation is through knowledge and understanding the benefits and costs of KM is essential (Dalkir, 2013). In Australia, as in a number of other developed/Western countries, KM is recognised as a highly important issue given the aging work force (Long, 2002).

2.3.2.1 The knowledge age

Knowledge and information are used interchangeably, as when information becomes useful or is turned into action it is converted to knowledge. Information can be seen live from around the world, board an aeroplane and data is relayed on position, time and speed instantly. At the click of a button, explicit knowledge can be transferred throughout the world through email and the like. Online databases allow information to be obtained from almost anywhere. News Agencies and reporters often use knowledge experts to convey a message or point of view. Small computers have hard drives that can store millions of pieces of information, which, a few years ago would require a super computer. It is often a case of information overload. People need the knowledge and skills to cope with this complex world we live in (Hislop, 2013). The amount of education required to live in society is increasing, 15 years is standard. Society is increasingly relying on expert knowledge, there is a pressing need to deepen understanding of the organisational conditions and processes that can sustain and foster its creation, circulation, distribution and reproduction (Nicolini et al., 2003).

Knowledge management has been evolving over many years (Hislop, 2013; Dalkir, 2013) as highlighted by Ghoshal and Bartlett (1998:43):

> Initially the Trades/Craftsman, then from
>
> 1835 The industrial revolution, then from
>
> 1911 Taylorism, General Motors – Alfred Sloan, Dupont – Pierre, designed to make people as predictable and controllable as the capital resources they must manage.
>
> 1949 A "professional management" approach, the way in which modern corporations had subjugated individual initiative and creativity to the perceived greater need for consistency and control.
>
> 1986 – Human capability and individual motivation. Jack Welsh CEO at General Electric – Treating employees as sources of initiative, energy, and creativity other than controllable costs. The talents of our people are greatly underestimated and their skills underutilized. Our biggest task is to fundamentally redefine our relationship with employees. The object is to build a place where people have the freedom to be creative, where they feel a sense of accomplishment – a place that brings out the best in everybody.

Cortada (1998:28) highlighted the reasons for the development in knowledge management:

(a) The globalisation of the economy, which is putting terrific pressure on firms for increased adaptability, innovation and process speed.

(b) The awareness of the value of specialized knowledge, as embedded in organisational processes and routines, in coping with globalisation.

(c) The awareness of knowledge as a distinct factor of production and its role in the growing book value to market value within knowledge based industries.

(d) Cheap networked computing, which is at last giving a tool for working with and learning from each other.

The profound changes under way in the world's economy will lead, if history is any guide, to continued increases in standards of living for many around the world. The amount of information and skills that everyone needs to perform their work has been rising steadily all through the nineteenth and twentieth century. For example, 90% of workers in chip manufacture never actually manufacture chips (Ghoshal & Bartlett, 1998). Knowledge workers deal in data and information on product. Confidence and willingness to assume responsibility rises as workers know more about what they do, why and how they do it. Better telecommunications are allowing firms to participate in many markets globally with minimal capital. Having the skills to develop, maintain, and exploit e-commerce is more than just an obvious requirement, it is simply quite a different world than a worker faced twenty years ago.

There is the history of the knowledge worker, that is to say, of people in many walks of life whose primary professional function is gathering and using information or knowledge (Drucker, 1993). Drucker's (1993:42) insights about the use of knowledge are:

1. From the beginning of time for humankind, people have recognised the value of consciously collecting and using information.
2. Humans have always tried to augment human memory with writing to aid in their preservation of information and knowledge for later use.
3. Humankind has constantly developed physical objects in which to store and manipulate information.
4. Every major institution in society has collected, preserved and exploited information.
5. Information begets more information; knowledge is a higher level of information.
6. Collections of information have normally lead to the creation of knowledge.

7. Respect for the value of information and knowledge has increased.

Bereiter (2013) argues that in today's Knowledge Age, education's conceptual tools are inadequate to address the pressing educational challenges and opportunities of the times.

Hence it is well known that we are in the knowledge age but what are the specific advantages and disadvantages of knowledge management?

2.3.2.2 Advantages of capturing knowledge

Knowledge, as by its definition, is very hard to store and identify in an organisation as it is intangible but if achieved effectively has many advantages. Key advantages of capturing knowledge include (Dalkir, 2013; Davenport & Prusak, 2000; Hasan & Handzic, 2003; Prusak & Matson, 2006; Tiwana, 2002):

- Improved learning
- Not redoing mistakes from the past
- Negating the need to re-invent the wheel each time
- As an actual resource or asset, considered "intellectual capital".
- Improved communication and morale by allowing people to transfer what they know.
- Greater use of the human asset – efficiency etc.
- Improved achievement of other organisational goals.
- Addressing issues of aging workforce, loosing critical personnel, getting people up to speed quicker and legal liabilities.

These advantages provide opportunity for organisations that are increasingly depending on their capacity to effectively mobilize and manage knowledge in order to fulfil their missions and thrive (Drucker, 1993, Nelson & Winter, 1982).

2.3.2.3 Disadvantages of not managing knowledge

Poorly managed knowledge in a company will eventually cause the company to fail in its strategic objectives and may affect its ability to weather through tough conditions because (Dalkir, 2013; Prusak & Matson, 2006; Tiwana, 2002):

- Problems repeat themselves
- Poor decisions made by management due to lack of information
- Loosing critical skills

- Reduced competitive advantage
- Poor use of existing assets
- Lost opportunities.

Clarke (2001) identifies five common symptoms showing that knowledge is managed poorly in the organisation;

1. Knowledge creation, transmission, and use remains unstructured (and hence, informal and often unconscious processes).
2. Decisions are often made without the benefit of the best knowledge available to the organisation.
3. Knowledge is not reused or shared, meaning staff either continually reinvent the wheel or duplicate the efforts of others elsewhere in the organisation.
4. People are overwhelmed with information that detracts from, rather than adds to their ability to do their job. (Paradoxically, creating a situation where staff experience simultaneous drought and flood.)
5. Knowledge hoarding by staff is common, and there is little organisational interest in the value of developing knowledge capacity amongst staff.

Hence, there are many disadvantages of not managing knowledge properly resulting in many hidden costs and lost opportunities in organisations, there are also the human related issues of not utilizing the intellectual capital and the aging workforce which is discussed in the next two sections.

2.3.2.4 People are the most valuable asset

Is it often said that people are the most valuable asset. It is the knowledge that a person possesses that is their most valuable asset and how they can apply that knowledge in practice to achieve organisational outcomes. In one of the companies this author worked for (Corning), it had identified a tangible opportunity to exploit its superior knowledge about human capital to provide a significant competitive advantage. This concurs with the findings of Boudreau & Ramstad (2013). It is the quality of human capital in terms of creativity, insight, entrepreneurship and innovation, that is the source of an organisation's or a country's competitive advantage (Thompson, 1995). But with the aging workforce in Australia, this most valuable asset is diminishing within the work force.

2.3.2.5 Aging Workforce

One of the major growing issues in Australia is the aging workforce as the "baby boomers" approach retirement (Kell et al., 2014; Long, 2002). The baby boomers hold a wealth of knowledge and experience which has not been captured in modern technology. In dealing with the financial burden, superannuation and non-compulsory retirement has also been introduced. However, this can also introduce additional safety risks as identified by Isernhagen (1991), the aging process affects the Neuro-musculoskeletal system and is translated into functional changes. The loss of functional work ability is noted in middle-aged and older workers. For those with chronic injuries and illnesses, aging changes add to the decrement in functional abilities. These workers hold a wealth of knowledge as noted, this knowledge needs to be captured to be utilized by future generations. Knowledge Management as a discipline can help to do this by capturing and transferring knowledge through principles and processes which can build on knowledge from previous generations and experiences.

2.3.3 Knowledge Management Principles

In this section basic types of knowledge (Section 2.3.3.1) of tacit and explicit are defined. Once these are defined, the actual place of knowledge compared to its earlier derivatives; data, information and learning (Section 2.3.3.2) needs to be explored. Then the knowledge life cycle (Section 2.3.3.3) is examined and as knowledge evolves and changes then the roles and skills (Section 2.3.3.4) needs to be determined to establish knowledge in an organisation. Finally, the principle of knowledge management and using this to create a knowledge culture (Section 2.3.3.5) is examined. After these principles are understood the specific tools and techniques are researched in section 2.3.4.

2.3.3.1 Types of knowledge

Knowledge is broadly classified into tacit and explicit. In simple terms explicit knowledge is the knowledge that can be written down and placed into documents; it is very specific, for a particular situation. Tacit knowledge is the knowledge contained in people's minds; it is more complex and cannot be easily interpreted. According to Dalkir (2013), explicit knowledge is that which is recorded and tacit knowledge is that which an employee possesses. It is very adaptable and varies depending on the situation or task. Wenger (1998:76) gives a broader definition:

"Tacit knowledge is above all, social, hence open-ended, subject to negotiation i.e. becoming knowledgeable in any field requires the participation in the interaction and engagement with the local web of meaning-making processes, that is, becoming a member of the group, community, or local culture that collectively sustains these interpretive processes"

Knowledge can be further classified in many different ways. It could be based on (Wenger, 1998):

- The age of information, in that the older the knowledge is the less useful it is.
- The location of the knowledge, whether it is in hardcopy, in computers or within peoples' minds.
- The intended use and by who, for example, knowledge stored by department.
- The source of the knowledge, such as media, books, computers and the internet.
- The industry or organisational function, such as, accounting or manufacturing knowledge.

2.3.3.2 Knowledge Vs. Data, Information, Learning and Wisdom

Knowledge is the end product of data and information. Data is raw information, numbers, words or facts. When this data is processed into some order or meaningful format it then becomes information. Information is then used to create knowledge that people use to carry out actions. The process is often represented in learning when new knowledge is created (Zadrożny, 2013). In-depth knowledge and understanding at a higher level may be considered as wisdom (Cortada, 1998).

2.3.3.3 Knowledge life cycle

Knowledge has a life cycle (Chen, Hwang & Raghu, 2010), what was useful ten years ago may not be useful today. The knowledge on how to use logarithmic tables is now obsolete as this is typically done by a calculator. New knowledge is continuously being created and utilised and old knowledge may not be needed. This represents a challenge in itself of judging which knowledge to loose and which to manage or develop (Davenport & Prusak, 2000).

2.3.3.4 Knowledge roles and skills

More and more companies are realising the need to manage knowledge (Daft & Marcic, 2013). Indeed many jobs are becoming knowledge oriented rather than physical. For example, in a

large US silicon chip manufacturer, for every 100 people in the plant only 6 actually touch and make the product, the remaining are knowledge workers (Ghoshal & Bartlett, 1998).

Wenger (1998) explains that the knowledge skills of workers are changing from an 'Organisational Man' which forces employees into homogeneity and conformity to an 'Individualized Corporation', which is flexible enough to exploit the idiosyncratic knowledge and unique skills of each individual employee. As companies adapt to the new multilateral, divisionalized structure of sophisticated capital allocating processes, managers were unable to adapt to the new roles and relationships that are more complex and less clear, but also the existing employees' skills and experiences were often unequal to the needs of new jobs.

Ghoshal and Bartlett (1998) explains how the change in knowledge skills has created a gap; 'Third generation strategies, 2nd generation organisations (systems) and first generation managers.' Hence, the proliferation of approaches such as quality circles, visions, empowerment, re-engineering and activity based costing. All very valuable but considered inadequate for the world transformation taking place. Particularly from an industrial age to an information intensive age of knowledge (Ghoshal & Bartlett, 1998).

As can be deduced from these insights, knowledge management has moved the skills required in the technology age workforce, from being physical in any way to being purely technical, allowing people with lesser strength and physical ability to be just as effective in society as anyone else, within reason. It has allowed people to work more flexibly and remotely at times, technology has bridged the gap, machines do more and more of the physical work.

2.3.3.5 Creating a knowledge management culture

Knowledge management is a culture within an organisation (Dixon, 2000, Nicolini et al., 2003). Nicolini et al. (2003) explains this in that KM becomes part of the way individuals work in the organisation. KM should not be seen as a separate activity but as a part of leadership (Ahmed, Lim & Loh, 2013). If it is a separate activity it indicates it has been poorly implemented and the full benefits of KM will not be achieved. Everyone in the organisation needs to think in terms of KM when carrying out their work. A shop-floor employee should think of the knowledge required to do the task. The front line managers need to ensure their staff has the knowledge to do their tasks effectively. Support staff and managers need to know what knowledge they control and how it should be best utilised. Senior executives should

ensure knowledge is captured and assessed and systems and processes are implemented. Nicolini et al., (2003) takes a broad philosophical, cultural perspective in that KM means collectives, and their acts, objects are the focus of acts, and the language used in the acts, together with site specific meanings and interpretation. In other words, a product is made by a collective knowledge and communication is through the product transfer. Hence to analyse knowledge culture it does not have to be through rituals and myths but rather on acts and interactions and artefacts (products). The communication of practice is what is missing in examining knowledge culture (Wenger, 1998). Ghoshal & Bartlett (1998:91) provide a more practical approach to creating a knowledge management culture by identifying three common characteristics of institutionalized entrepreneurial practices which engender a knowledge culture:

1. Inspiring *individual initiative* requires that individuals feel a sense of ownership in smaller organisational units, belong and make a physical impact.
2. Align frontline initiatives with companies' overall direction through *self-discipline* from below, not control from above.
3. Management needs to reflect its respect for the individual in a supportive *knowledge culture* open to questioning and allowing some failure.

Ghoshal and Bartlett (1998:92) explains further how this can be achieved:

Individual initiative through:

i. Creating small performance units (managers not to measure and reward but create environment to support individuals).
ii. Radically decentralised resources and responsibilities brought closest to the customer and the most knowledgeable. As an example; 10% of resources are allocated to corporate functions and 90% to frontline operations, management still reviews and approves through a local board.

Developing *self-discipline* – people return calls promptly, meetings on time, deliver on promises.

i. Clear standards and expectations to replace control such as the 'balanced scorecard' approach (See section 6.3.13).
ii. Information democratisation. Systems designed to serve the needs of frontline managers, not to control and measure them. Every manager becomes his/her own controller through performance measures, all

managers receive same information in return which can go right down to team leader level.

iii. Peer Comparison Challenges. "Performance league tables" comparing performance of frontline companies for review, comment and action, also used for best practice purposes. Self-motivated learning proved much more powerful than top management intervention.

Providing a supportive *knowledge culture*:

Many employees do not have the attitude, knowledge and skills to operate in a more free environment, they need coaching and support. When employees can take responsibility for setting and monitoring his or her own objectives and standards. An environment in which individuals could acquire the knowledge and skills to assume self-management through one-on-one coaching. This can be achieved through:

i. Management coaching – Restructuring is easy compared to the difficulties of redefining managers' roles and progressing them from specialists to managers and from managers to leaders.

ii. Openness to challenge – Opening company policies and top level decisions to question give a sense of membership. Managers ask "What do you see that I am missing?"

iii. Tolerance for failure – Management that is critical when mistakes are made may discourage initiatives, risk taking and learning.

This helps to explain how to create a knowledge culture but there is a requirement to have more practical tools and techniques which will implement such a culture.

2.3.4 Tools and Techniques for Knowledge Management

There are many tools and techniques for knowledge management (Rao, 2012). It is beyond the scope of this study to examine all of these in detail. However, based on a comprehensive literature search, the most relevant topics have been considered for this study. Firstly, the role of information technology (Section 2.3.4.1) in KM is fundamental and one of the reasons why KM has gained such popularity. This is related to the techniques for knowledge transfer (Section 2.3.4.2), capturing knowledge (Section 2.3.4.3) and knowledge systems and processes (Section 2.3.4.4) that often utilize computers. Next, the responsibilities for KM (Section

2.3.4.5) in an organisation are examined as well as the individual skills and abilities (Section 2.3.4.6) required. This is followed by some specific tools of face-to-face communication and KM (Section 2.3.4.7) and knowledge maps (Section 2.3.4.8). Knowledge management projects (Section 2.3.4.9) are then considered as a way of introducing KM into an organisation. Another important technique is to then further develop the knowledge (Section 2.3.4.10) and finally to link it strategically (Section 2.3.4.11) to the organisation.

2.3.4.1 Information technology and Knowledge Management

Information Technology has helped the collaboration, collection and dissemination of knowledge (Choi, Lee & Yoo, 2010). Collaboration has taken place through the internet and more complex message boards, chat sessions etc. Collection has occurred due to large data storage capabilities. A whole library of books can now be stored on a common computer. Dissemination of data and information, once stored on large restricted databases accessed by only a few people, can now be searched and accessed in many other locations by many individuals through the World Wide Web. Information technology can be seen as the driving force for the KM age, however it does create a number of issues relating to (Ghoshal and Bartlett 1998):

- Integration of networks and communication infrastructure.
- Locating and retrieving relevant information – examine how hard it can be to find specific information on the internet.
- Information technology will not fix underlying issues that facilitate KM, cultural issues relating to trust, openness and sharing of knowledge are often more critical.

2.3.4.2 Knowledge transfer

Knowledge is of no use unless it can be transferred to another situation or indeed the same situation again. Without transfer there is no need to capture the knowledge and the advantages of KM will not be achieved. Dixon (2000 and 2012) describes five types of knowledge transfer: Serial, Near, Far, Strategic and Expert. This is covered in more detail in section 2.3.4.3.

2.3.4.3 Capturing Knowledge

One of the most important aspects of KM is the capturing of knowledge for future use and benefit. Organisations are equated with entities that process information, reflect on experience, and in this way acquire knowledge. To the extent that they modify their internal system of

beliefs and their actual or potential behaviour repertoires (Feil & Lyles, 1985, Kim, 1993). It is commonly known that the largest supercomputer cannot simulate the exact thought processes that go into a task as simple as driving a car (Dixon, 2000; Dixon, 2012). Attempts to document in detail the knowledge critical employees contain has been very hard, in some cases, unachievable. A multi-disciplinary approach should be taken as identified by Dixon (2000) who concentrated on the knowledge transfer, not just the storage of knowledge as many information technology approaches examine. Dixon identified five types of knowledge transfer:

1. Serial Transfer – the team does a task and the same team repeats the task in a new context – the source team and those receiving the knowledge are the same with the aim to decrease repeated mistakes.

2. Near Transfer – transfer from the source team to a new team for a similar task – routine repetitive – explicit with the aim for best practice.

3. Far Transfer – Tacit knowledge from a source team to a receiving team for a non-routine task, leveraging people who have specialized knowledge.

4. Strategic Transfer – complex knowledge teams separated by time and space broader scope than Far Transfer involving both tacit and explicit knowledge.

5. Expert Transfer – explicit knowledge applied infrequently to problems which are not easily interpreted or cannot be clearly stated in a procedure.

2.3.4.4 Knowledge systems and processes

In order to effectively manage knowledge, appropriate systems and processes need to be developed. It is the specific components that make up the KM system of an organisation, such as the organisations' development system for obtaining new knowledge (Levine et. al. 2013). This may be the online intranet and how that is managed or it may be the physical meeting process for face-to-face knowledge transfer. Knowledge is a social process and tools can be used to facilitate the social learning and knowledge transfer (Ghoshal & Bartlett, 1998).

For the five types of knowledge transfer Dixon (2000) provides the following examples of systems or processes:

1. Serial Transfer – Often carried out face-to-face with a meeting or review before or after an event, eg. US Army's 'After Action Review (AAR)' procedure.

2. Near Transfer – Use of a database and scorecard mechanisms, such as the Best Practice Replication used by the Ford Motor Company or the Alert Notification System used at Texas Instruments.

3. Far Transfer – Using specialists and connecting to them, such as Peer Assist program within BP where specialists come out to help or Capital Project Management program at Chevron.

4. Strategic Transfer – cross-functional teams with a broad range of skills, such as Knowledge Assist in BP or Centre for Army Lessons Learned (CALL) in the US Army.

5. Expert Transfer – used to leverage off the knowledge of others in an organisation, such as discussion groups which use databases and systems, such as Technical forums at BP.

2.3.4.5 Responsibilities for Knowledge Management

KM is not a point sensitive approach, if it is, it is not as effective. KM is a company-wide approach and needs to be entrenched in the company culture (Dalkir, 2013). Hence, KM is everyone's responsibility and systems and processes should be in place at all levels of the organisation for knowledge capture and transfer. If one person is not included or involved they may contain key knowledge for a particular situation or problem which could be lost. Ghoshal & Bartlett (1998) report that councils on total quality, purchasing, human resource, and other key staff responsibilities provided the linkage point that allowed functional experts in various companies worldwide to compare performance and transfer best practices on a routine basis. KM should be integrated into other systems such as performance reviews, the IT strategy, training etc.

2.3.4.6 Individual skills, abilities and Knowledge Management

The skills and abilities of KM are wide and varied and cannot be obtained by one individual but rather be channelled from one person to another, depending on the situation. However, for KM to be effective the following skills are required (Daft & Marcic, 2013; Nonaka et al., 1996):

- Zest for information.
- Good communication and liaison skills.
- Computer and systems knowledge.
- Project management abilities.
- Able to move around the organisation at different levels.
- Able to sell new concepts and ideas.

These skills need to be developed and referenced in personnel job descriptions and incorporated into the recruitment process.

2.3.4.7 Face-to-Face Communication and Knowledge Management

This researcher suggests that too much of the literature and professionals in knowledge management are focusing on the information technology side as this only manages the explicit knowledge. However, the tacit knowledge that is in peoples' memories can often only be obtained through experience and communication. This is achieved to a large extent by social interactions of face-to-face communication. People need to build relationships and rapport before effective knowledge transfer can occur (Dixon, 2000; Dixon, 2012).

2.3.4.8 Knowledge maps

Another effective tool for KM is the creation of a knowledge map (Trumpower, Filiz & Sarwar, 2014, Feil & Lyles, 1985). This is basically a register of what knowledge exists in the organisation and where it should be kept and it should be continually updated to be current and to make it a valuable resource. For example, a type of 'white pages' of who knows what or a skills database of who worked/works on what projects/processes.

2.3.4.9 Knowledge management projects

KM needs to be first incorporated into the philosophy of the work and introduced to the organisation through a key initiative or project. Typical steps of a KM project are as follows (Ahmed, Lim, & Loh, 2013, Davenport et al., 1998):

1. Set up a team with people who have a passion for enhancing knowledge.

2. Carry out an audit of KM
3. Identify key knowledge
4. Identify how to capture or manage the knowledge
5. Introduce key aspects and elements through a strategy
6. Implement and monitor the strategy.

It is important that the KM project covers all of these steps to be fully effective in creating a KM philosophy or culture.

2.3.4.10 Developing knowledge

Developing knowledge is about creating and building on existing knowledge in the organisation (Dalkir, 2013). This helps to better utilize the existing knowledge but also to tap into other knowledge beyond the boundaries of the organisation. As the complexity of the knowledge required increases, the greater the need to utilise external knowledge. It is not possible for an organisation to be up to date on all legislation that applies to it, without allocating considerable resources, hence external knowledge is tapped into the information network as the following quote explains:

"Technology mature firms, with the ability to identify a firm's scope for efficient specialisation in technological activities, to extend and deepen these with experience and effort and to draw selectively on others to complement its own capabilities." (Lall, 1994:268)

2.3.4.11 Alignment with strategy

For KM to be successful and improved in an organisation, it needs to be linked to the core strategy and goals of the organisation. It needs to be part of the value added processes that the company is involved in (Hislop, 2013; Davenport et al., 1998). For example, for a paper manufacturer, the KM should be linked to the knowledge needed to manufacture paper and for a hospital KM should be linked to the knowledge required to treat patients.

2.4 The application of knowledge management principles to safety

There has been limited research on safety and KM specifically, however, throughout the literature there are links or implications of knowledge and KM through other means. Perhaps it is a lack of understanding amongst safety professionals of what KM is and amongst KM

professionals of what safety is. Firstly, the definitions that combine safety and KM are examined to create the link (Section 2.4.1). Secondly, a critical distinction or rather discussion point is presented on the difference between KM and safety training (Section 2.4.2). Thirdly, there is the link established between risk management the basis of safety and between risk management and KM (Section 2.4.3). Finally, a point of discussion between KM and safety management (Section 2.4.4) functions such as incident investigation and audits or inspections is presented.

2.4.1 Safety and Knowledge definition

Often when we talk about safety we are assuming a level of knowledge by individuals. It is often stated by safety professionals that a common response from management is "it was common sense!" What in actual fact they are saying is that the individual should have the knowledge not to perform the task in an unsafe behaviour that could have resulted in an accident. Roughton (1993: 128) concurs with this by using knowledge to create the link to safety behaviour:

"*Organisational knowledge also includes the understanding that unsafe acts and conditions are the critical common pathways from which injuries arise. Thus the ability to control behaviour, distinguishes those organisations with low accident frequencies*."

Hence, often when one refers to safety and people acting safely they are implying a level of knowledge.

2.4.2 Knowledge management and safety training

Safety training is very common and widely used in industry and seen as a way of improving safety performance and creating a safe culture. However, it is important to distinguish between safety training and safety knowledge, which is the desired outcome, see sections 2.2.1 and 2.3.1. Weinstein (1997) recognised the all important distinction of knowledge as opposed to straight training stating that knowledge enables the organisation and the employees to achieve and to continuously improve. He goes further and creates a checklist of employee knowledge based on work by Solomon (1996) and (Brown, Hitchcock & Willard, 1994)

In assessing organisational and employee knowledge (Weinstein, 1997:26):

- *Does the organisation and our entire workforce exhibit the kinds of knowledge and characteristics necessary to achieve work safety objectives?*

- *Do we generate new ideas for safety management?*
- *Do we adapt ideas and techniques from others to enhance safety?*
- *Do all our people understand quality and work safety programs and their core principles and do they have all the skills necessary to work safely?*
- *Do our people strive to learn more and develop their skills?*
- *Do employees participate in the training program other than as students?*
- *Is there a minimum safety skills and knowledge level set for employees?*

Similar checklists have been developed by Colvin (1992), however they appear to be more training outcomes rather than knowledge creation as they do not define what occurs in practice nor define the competencies obtained in practice. Take for example a paper by Allenby et al., 2002), titled "Managing Environment and Safety in the Knowledge Economy". In actual fact the paper is all about AT&T's web based electronic EH&S system which is an information system, however without the creation of knowledge within individuals, the system will do little more than record basic information. However, the real value of the system is in the knowledge that an individual possesses that has been transferred into the system which can be utilized elsewhere. Hence, it is important to recognise that training should focus on knowledge creation and the systems and processes associated with knowledge transfer. One way to create safety knowledge through training is by using a risk management approach as explained in section 2.4.3 below.

2.4.3 Risk management and knowledge

Knowledge management can be linked to safety through the overall risk management of an organisation, The British Standard Institution (BSI) takes this point of view in their publication, "Linking Knowledge Management with other Organisational Functions and Disciplines: A Guide to Good Practice" (BSI, 2005). Risk management is a discipline that organisations can no longer afford to ignore, if they are serious about both mitigating the effects of the threats their operations encounter and seizing opportunities that are passed their way, perhaps KM should sit right at the heart of their risk management strategy. The BSI report is very useful in terms of KM, however, it does not link it specifically with the safety function and hence can lose the effectiveness to improve safety performance. Manuele (2013) very appropriately links KM with the risk control hierarchy by creating an innovative "safety decision hierarchy". In this model the safety practitioner is armed with a decision-making tool that can be applied in

practice. He describes specific safety actions that can be done at the design stage and during task analysis as well as a risk scoring mechanism that is less subjective. So, in fact, Manuele converts the traditional risk management approach, where information is taught traditionally, into actions in practice. This is what safety knowledge is about. Hence, there are specific objectives that are measurable which can be achieved. Weinstein (1997:22) supports this in a broader context in terms of safety objectives:

"The organisation would need to demonstrate that the organisation and the workforce exhibit the knowledge and characteristics necessary to achieve workplace safety objectives"

2.4.4 Safety Management and Knowledge Management

The safety principles such as incident investigation, risk assessment, workplace audits etc. are only as good as the knowledge of the people performing them. A very important piece of work by Griffin and Neil (2000) conducted in Australia recognises the vital link that KM creates in safety (See Figure 2.4). They studied safety climate and safety performance and determined a model as to the link between the two. They concluded that safety climate is an antecedent to safety performance in organisations. More critically, that the determinants of safety performance were knowledge and skill motivation which acts as the link between safety climate and safety performance.

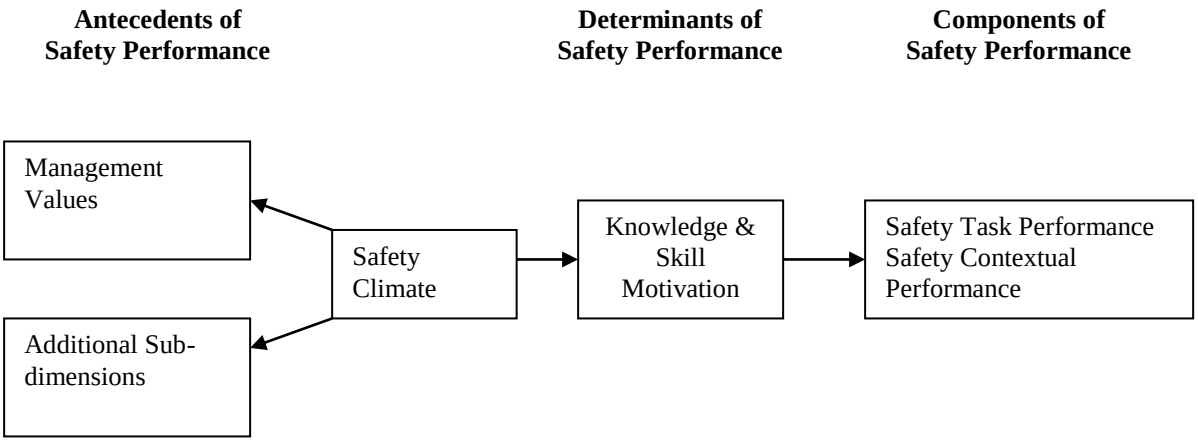


Figure 2.3: Model to link safety climate and safety performance through knowledge and motivation

(Source: (Griffin & Neil, 2000))

The model presented in Figure 2.3 provides a good link between safety management and KM, however it has a number of limitations as noted by the authors themselves. Firstly, the study did not specifically measure safety performance, it was based only on perceptions. Secondly,

the study did not test the model through a longitudinal study. Finally, there was no specific test of skills obtained. Many of these issues are addressed in this current study. Another important study which examined safety and KM is by Burke et al. (2002 and 2011) concerning the depth of knowledge of specific tasks in relation to safety performance. This study focused on the specific knowledge of tasks rather than perception factors, so it addresses one of the limitations in Griffin and Neil's work. Specific factors included in the Burke et. al. study included; using Personal Protective Equipment (PPE), engaging in work practices to reduce risk, communicating health and safety information, and exercising employees' rights and responsibilities. The study concluded that a detailed knowledge of safety principles was a good predictor of overall safety performance. However, this study still had limitations, in that like Griffin and Neil, it lacked a longitudinal study and effective measures of safety performance and again used a worker's perception of safety performance. However, the study concluded the importance of safety knowledge and how safety management and KM are related.

Thus, the literature shows a path from traditional safety management of information and training to KM including knowledge creation and transfer. This is the focus of this study which then is used to test the research question proposed.

2.5 Summary of Chapter 2

In examining the literature the complexity of the study was better understood and led to the direction of the study going forward. The review covered the definitions of the two disciplines: safety management and knowledge management. This was followed by a study into the key principles, specialist areas and a brief history of safety management. Then a basic introduction into knowledge management followed by a study of the principles, tools and techniques of knowledge management. Finally the review involved an analysis of literature that had strong links with safety and knowledge management. As the study was conducted over a few years this literature review was continually updated throughout the study.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter provides the logic and reasoning behind the research methods used and how they are integrated into a research design. Section 3.2 includes a brief analysis of the knowledge management and safety fields with respect to the research approaches used. Section 3.3 describes the techniques chosen for this research and how they incorporate the requirements of the DBA thesis. Section 3.4 introduces the research design and describes each of the components. Section 3.5 assesses the quality and rigor of the research. Section 3.6 gives a summary of the research design and methodology chapter.

3.2 Safety management and knowledge management research

3.2.1 Safety Management

The occupational health and safety academics and practitioners are increasingly turning to management literature to guide safety research. Occupational health and safety researchers have explored a variety of approaches, however increasingly each approach is focusing on the individual as the unit of analysis, i.e. most studies are done on individual cases or projects (Barling, Kelloway and Iverson, 2003; Reason, 1997; Bohle & Quinlan, 2010). Such as, a review of a large construction project and the success and failures with respect to safety conducted by Cowley (2008). Other studies are done on the success of individual companies, however often they lack the ability to stand up to academic and statistical rigour. There are many studies of safety performance, safety culture and aspects of safety but little research-based analysis that would stand up to close scrutiny and statistical rigour. For example, the most basic of safety definitions, the Lost Time Injury, is flawed in terms of statistical significance as in most medium to small sized companies the sample size of the number of employees is too small, as to be statistically significant the sample size should be greater than

500 (see the statistics element in Chapter 6). There are several reasons noted by the researcher as to why current research is limited and not comprehensive:

1. The definition and recognition of safety as a profession is not well recognised, compared to professions like accounting, thus limiting safety management development.
2. The number of safety sponsored research projects is small.
3. The actual information or data available to identify the need for research is limited.
4. The lack of consistency in measurement and data on safety.
5. The impact of safety directly such as the number of injuries is limited but also indirectly the costs are hard to identify, limiting the financial justification for this type of research.
6. The fact that it is a very individual and human based discipline.

However, good research can be found with respect to large disasters and physical injury measures, such as workers' compensation rates (ASCC, 2006).

Safety is often, as a discipline, closely associated with Human Resources (HR), hence techniques used for HR are also used for safety. Human resources comes under the broad area of management research, hence one needs to examine management thinking and research. This area is distinguished by three characteristics:

(i) the research is eclectic in its approach and crosses a number of traditional disciplinary boundaries;

(ii) researchers may only have limited access to managers and their organisations, because managers are active and powerful people;

(iii) most business research requires thought and action, access to organisations may only be available where there is some personal or commercial advantage.

There is an expectation that business research will provide the potential for action to be taken as a result of the outcomes of research. This is particularly true in the case of safety and is evident in this body of research. As safety is a very complex field overlapping with the behaviour based sciences, through to machine engineering, through to human anatomy and chemical response and not least of which includes training and human resources aspects. Also, in practice, it is hard to obtain agreement and time from the employees to participate in safety research. Finally, there had to be a commercial advantage for the organisations studied in that

they required the research to develop recommendations for improvement (See Climate surveys I and II in chapters 5 and 7). This shows there is a strong relationship between safety research and its parent discipline of management research. Hence, a study of management thinking and research that parallels with safety is required. Table 3.1 gives a summary of management research throughout the ages.

Ever since man has embarked on major projects, there has been a need for management and indeed safety; however safety was not well recorded in these earlier projects (See Table 3.1). Such as the building of the Pyramids, The Great Wall of China, Roman cities and other ancient wonders. Management thinking was still progressing through the Middle Ages as complex cities, cultures and organisational structures developed such as the Catholic Church. Venetians developed a legal framework for sea commerce, early assembly lines for ships, which obviously had the human element and the earliest stages for which safety would need to be introduced. Later, the introduction of the division of labour and specialist jobs by Adam Smith (1910) in large manufacturing organisations, for which safety was first considered and still exists as such a concern in today's modern factories. This led to the classical school of scientific management and administrative theories which involved time and motion studies and production scheduling (Taylorism). Taylor came up with four principles of scientific management (Waring, 1991: 16):

1. The manager should develop a science (one best way of working), for each component of the job.
2. The manager should scientifically select the best person for the job and train the worker.
3. The manager should cooperate with the workers to ensure the work is done in accordance with the scientific steps developed.
4. The manager should assume all management activities, allowing workers to get on with their jobs.

Here we already start to see the aspects that still exist today in safety legislation, training and consultation through cooperation.

School of Thought	Researchers/thinkers	Management ideas
Ancients	Sumerians (3500 B.C.) Babylonians (2000-1700 B.C.) Egyptians (4000 – 2000 B.C.) Romans (300 B.C. – 300 A.D.) Chinese (1500 B.C. – 1300 A.D.)	Planning and coordination for cities, armies, government, etc.
Middle Ages	Venetians (450 A.D. -1500 A.D.)	Legal frameworks for sea commerce, early assembly line for ships.
Renaissance	Machiavetti (1469-1527)	Politics and power
Industrial Revolution	Adam Smith (1723-93)	Division of labour, market forces
Classical School		
Scientific Management	Fredrick Taylor (1856-1915)	Principles of scientific management.
	Frank Gilbreth (1868-1924) Lilian Gilbreth (1868-1972)	Time and motion studies, welfare of employee important.
	Henry Gantt	Production scheduling, Gantt chart
General Administrative Theorists	Henri Fayol (1841- 1925)	Fourteen general principles of management.
	Max Webber (1864 – 1920)	Introduced concept of bureaucracy and professional management.
Behavioural Approaches		
	Hugo Munsterberg (1863 – 1916)	Founded industrial psychology
	Mary Parker Follett (1868 – 1933)	Important role of individuals and groups in organisations.
	Chester Barnard (1886 – 1961)	Importance of communication and social relationships in organisations.
	Elton Mayo (1880 – 1949)	Importance of human factors in work behaviour, Hawthorne studies 1927-1932
Human Relations Approaches		
	Abraham Maslow (1908-1970)	Hierarchy of needs
	Douglas McGregor (1906-1964)	Theory X workers lazy; theory Y workers need full potential developed.
Modern Approaches		
Quantitative approaches (also called management science, operations research)	Robert McNamara, Charles Thornton, various others, post-World War II	Application of statistics, mathematical modelling, computers to planning and management.
General Systems Theory	Von Bertalanffy (1972)	Organisation seen as a series of interdependent parts – a system.
Contingency Approach	Fredrick Fiedler	Every situation is unique – no one best way of managing.
Japanese Management Influences	William Ouchi (1981)	Theory Z – hybrid US/Japanese management style.
Culture and Power Approaches	French and Raven (1959), Clegg and Dunkerley (1980), Clegg (1989)	Recognises role and importance of power, politics and culture in organisational functioning.

Table 3.1: Development of management thinking and research

(Source:Ticehurst and Veal (2005))

Frank and Lilian Gilbreth (1868-1924) extended the work by Taylor and experimented with optimisation (Ticehurst & Veal, 2005). Critically they took a view that organisations must take the welfare of individuals into consideration. Hence, this notes the real beginning of modern safety management.

However, researchers then realised the complexity of human behaviour and interactions and formed more behaviour based models. It moved away from the more supervisory models to a more collaborative approach. Behaviour based approaches were developed by Mary Parker Follett (1868-1933), Chester Barnard (1886-1961) and Elton Mayo (1880-1949). Elton Mayo further studied people's responses to change in the environment and looked at factors like lighting etc., which still exist in safety today. He developed the famous 'Hawthorne studies' that showed employee attitudes and workplace relationships were more important determinants of workplace efficiency than the more physical and scientific factors. The human relations movement was then to follow most commonly known as 'Maslow theory' (1908-1970). He proposed a hierarchy of needs, starting with physical and physiological needs, then safety and security needs, love and social needs, ego and status needs and finally self-fulfilment needs (Ticehurst & Veal, 2005).

Finally, we have more modern approaches. Quantitative approaches such as operations research, based on statistics and mathematical modelling. Systems theory examined inputs and outputs and interaction with the external environment, including Japanese management influences that offered employees the prospect of long-term employment, collective decision-making, and several other factors. A key aspect in this case is the holistic concern for employees and their family members which is very much influenced by the outcomes of injuries to employees. Culture and political power is another modern approach where managing the relationships between different interested parties in a work environment is a key concern for managers, including negotiations with unions where safety is often used as a power struggle between management and staff. It is this relationship that resulted in the first instances of legislation. Thus, safety management is closely linked to management as a research field but still heavily regulated and human resources based in most organisations.

3.2.2 Knowledge Management Research

Knowledge management appears to be a more researched and advanced field than safety even though the discipline is a more recent development. However, many studies are associated around the information technology perspective and data collection and analysis (Bradley, 1989; Kwan & Balasubramanian, 2003; Allenby et al., 2002)). Hence the developments have largely been driven by the advances in computers and attempts by computers to capture human-based knowledge in systems, as an aid to bridging the gap between information technology (IT) and human aspects. Often these studies are associated with analysing the information contained in computer systems and hence are a secondary data analysis which is used to determine the success of a particular system or to determine generic conclusions about knowledge management. An example is the work by Desouza (2003) which looked at category based contributions to a database to determine if gaming rooms should be encouraged for knowledge transfer. Kwan and Balasubramanian's (1998) study looked at usage statistics of the IT system implemented as well as conducting unstructured telephone interviews with a dozen users. This study showed that the analysis of raw data and statistics alone is insufficient and highlighted the need for an assessment of the users' experience and interaction with the system as well. Bradley (1989) used a structured experiment with subjects examining different aspects of knowledge management followed by a questionnaire survey. In summary, the common approaches used in the knowledge management research field are:

1. Case studies and generic experiments of system design components.
2. Questionnaires to determine individual responses to knowledge management systems and aspects.
3. Statistical analysis of knowledge management systems content.

3.2.3 Limitations of previous studies in safety and knowledge management

For the present study a range of both knowledge management and safety approaches is used to test the proposed model and research question. Significant studies that have combined the knowledge management and safety fields as noted in the literature review include works by Burke et. al. (2002) and Griffin and Neil (2000). Burke et. al. (2002) studied the waste industry and work in hazardous waste, examining four critical safety aspects across four different companies. The authors conducted analysis of perceived 'depth of knowledge' against the known safety aspects to the safety performance. A factor analysis was then carried out to

determine the research question that the depth of safety knowledge is more important than the breadth of safety knowledge. The limitations identified in the work by Burke et. al. (2002) were as follows:

1. A more composite or overall safety score would be more useful than safety performance measures.
2. Measures of safety knowledge and performance were based on workers' perceptions rather than measured safety performance.
3. The number of safety aspects considered could be broader than the four used in the study. This would also allow for a readily acceptable transfer to other industries.
4. The breadth of the industry chosen, hazardous waste disposal, has limited scope and may be skewed by the very nature of the industry.

Involving 1,264 employees from a range of Australian mining companies and the second involving 371 employees from three Australian manufacturing companies Griffin and Neil (2000) conducted two questionnaire surveys associated with the audit process. In each study the respondents were required to rate 81 questions on a Likert scale from 1-5 in terms of strongly agree to strongly disagree. Factor analysis was carried out to determine whether safety climate had an impact on safety performance. The study did support the proposed model and was linked through knowledge and skill motivation (see section 2.4.4 in chapter 2). The limitations identified by Griffin and Neil (2000) were:

1. The study did not measure specific safety performance but rather perceptions of safety performance.
2. The study was at one point in time, it was not longitudinal.
3. The study did not test the specific skills as applied to the workplace.

This present study uses a range of techniques and approaches to try and overcome the limitations of previous work and thus expands on this research and further contributes to the field of safety and knowledge management. Two major techniques used to help overcome these limitations were that the study was longitudinal and involved triangulation which is explained in the next two sub-sections.

3.2.4 Longitudinal Study

A longitudinal study involves the study of individuals or organisations over a period of time. Such studies are ideal for studying organisational change which is what this research is related to. According to Stebbins (1992), the change in safety performance is the critical aspect of the research question to be tested. The main data and analysis of this study was conducted over three years, the first climate study was conducted in July 2005 and the second climate study was conducted in July 2008. The performance data identified in section 3.3 was collected on monthly basis during this time, ensuring the study was longitudinal.

3.2.5 Triangulation

The use of different research approaches, methods and techniques in the same study is known as triangulation. Jick (1979) contends that triangulation has vital strengths in that it encourages productive research, enhances qualitative methods and allows the complementary use of quantitative methods. In this study, methodological triangulation is used involving both quantitative and qualitative methods of data collection (Easterby-Smith, Thorpe & Lowe, 1991). Triangulation allows for two independent data sources and methods to verify a research hypothesis. Hence, quantitative data measures the improvement but also qualitative data in the climate surveys verifies the data by feedback and analysis from the questionnaire of staff. If both concur with the research findings it is a much more credible result, than one or another of the approaches. However, it does have some limitations in that is requires more data, analysis, resources and time to produce the results. This approach in this study has helped to overcome the limitations identified by Burke et al (2002) and Griffin & Neil (2000), as discussed in the next section.

3.3 Research techniques chosen

The research techniques chosen for this research consist of a range of approaches due to the limitations and benefits of each research approach. Firstly, a summary of how this study overcomes some of the limitations of previous work is presented. In response to the limitations presented by Burke et al., (2002):

1. A more composite or overall safety score is more useful for measuring safety performance

This study uses a range of safety measures of performance including both leading and lagging indicators for safety. In all, 14 measures are included in the 'safety scorecard' (more information and definitions can be found in the safety scorecard practical application in section 6.3.13:

Lagging Indicators (safety measurements after an injury has occurred)

- Lost Time Injury Rate
- Major Injury Frequency Rate
- All Injury Frequency Rate
- Severity Rate
- Employees on Restricted Duties
- Employees not at Work
- Workers Compensation Premium per Employee
- Workers Compensation Claims Costs per Employee

Leading Indicators (safety measurements before an injury occurs)

- On Time reporting of injuries
- Risk Assessments Completed
- Workplace Audits Completed
- Safety Actions Completed
- Toolbox Talks Completed
- Incident Investigations Completed

2. Measures of safety knowledge and performance are based on workers' perceptions rather than measured safety performance

The above 14 measures are based on actual measurable results, the safety climate surveys as part of this study are used to examine perceptions but safety performance is based on these non-subjective measures.

3. The number of safety aspects considered are broader allowing for a readily acceptable transfer to other industries

This study includes an examination of 16 different safety aspects as practical applications, rather than just four used in the study by Burke et. al. (2002). However, due to such a scope the safety aspects examined are both subjective and non-subjective. The safety surveys do introduce specific safety knowledge aspects and non-subjective safety measures, again many of these are based on individual perceptions.

4. The breadth of the industry chosen, hazardous waste disposal, has limited scope and may be skewed by the very nature of the industry

This study is only limited to two companies, however, one of which is a large multinational corporation covering the following: Recycling, Heavy Manufacturing, Light Manufacturing, Transport, Printing and Displays.

In response to the limitations identified by Griffin and Neil (2000):

1. *The study did not measure specific safety performance but rather perceptions of safety performance*

The new safety scorecard (Juglaret et al., 2011) developed in this research specifically measures safety performance over the three years of the study using 14 different safety measures, thus removing the issues and bias associated with perception.

2. *The study was at one point in time, it was not longitudinal*

The present study is longitudinal conducted over three years with a detailed survey at the beginning and at the end and measures continuously along the way with the scorecard collated each month (reviewed annually for the purpose of this study), hence is over many years and not one point in time.

3. *The study did not test the specific skills as applied to the workplace*

The present study tests specific skills as applied to the workplace. The specific measures and actions are practically applied to the workplace; through the 16 practical applications including use of workplace audits. Other leading indicators such as risk assessments conducted in the workplace are also specifically measured (See chapter 6).

3.3.1 Qualitative and Quantitative Research

Primary and secondary data sources were used in this study. Primary data sources were used as they offer a good basis for statistical analysis, they are measurable results that can be analysed, such as the safety performance measures, they will be analysed over time in this longitudinal study. The data collected in this study is original data, never collected before, and therefore a significant contribution to the knowledge in this field of research on its own. Secondary data

sources were also used, such as, workers' compensation statistics, a measure which come from the insurers systems and databases.

Quantitative research has benefits in terms of statistical analysis of numerical evidence to draw conclusions. It often relies on large amounts of data to be statistically valid, hence can have its limitations in terms of resources and practicality. In this study, there were defined time frames for which outcomes needed to be achieved. For example, each safety climate survey had to be completed within three months so that the results could be used in developing recommendations for the company's overall safety strategy. The climate surveys and recommendations were derived from questionnaire surveys, from observation and secondary data sources.

Qualitative research has it benefits in that it helps to gain a more in-depth understanding of complex issues, such as safety. Often it will involve a much smaller number of subjects but examined in much more detail. Techniques used include observation, informal and in-depth interviewing and participant observation (Ticehurst & Veal, 2005).

Rather than debate over which research methodology to use, it is best to use a combined approach, as used by Dixon (2000) and Jemison (1981). It can also be argued that the two approaches are moving together (Fielding & Lee, 1991) with advances in statistical analysis techniques and the use of computers. This study uses a variety of both qualitative and quantitative data: quantitative data in terms of safety scorecard and questionnaires and qualitative data in terms of short answer questions included in the two safety climate surveys, case studies and observations in the practical applications.

3.3.2 Case study research

Case study research involves a research strategy which focuses on understanding the dynamics present in a single setting and can be at various levels (Yin, 1984). Case studies can be used to provide a description (Kidder, 1982), test theory (Anderson, 1983) or generate theory (Gersick, 1988). In this study it is used to test a theory or research question, in that the application of knowledge management principles can improve safety performance. From a micro perspective, two case studies are included as part of the exploratory analysis conducted at Pilkington Glass. From a macro perspective, the embodied research at the principle organisation, Visy, can be

seen as an in-depth case study. A case study is a good method for capturing in-depth information on a particular subject and to identify measurable improvement or change.

3.3.3 Questionnaire Surveys

Questionnaire surveys are common in management research. Many studies on safety have used questionnaires (Burke et al., 2002, Griffin & Neil, 2000, Hofmann & Stetzer, 1996, Rundmo, 2000). These allow for specific data to be controlled and collected and typically depend on respondents' own accounts of their behaviour, attitudes or intentions (Ticehurst & Veal, 2005). Surveys have been collected for this research as they allow particular data that can be quantified and analysed. Surveys also allow for the consistent collation of information and are less subjective than case studies. More detail on the questionnaire surveys can be found in section 3.4.5.

3.3.4 Interview research

Interviews are a good research technique to investigate and gain a more detailed understanding of issues. Interviews were used in the study to gain a better understanding of the opinions of relevant participants. For example, a survey may ask, "Has safety improved in your area in the last two years?" The answer can come back as a straight 'yes' or 'no' with little understanding of how, also the time frame may be wrong and thus influence the 'yes' or 'no' answer. In an interview situation a follow up question could be asked, such as "In what ways has safety improved or not?" The issue that arises with interviews is that if they are not well structured it may be difficult to quantify the results because of the amount of variation in responses.

The qualitative data was analysed by first recording each of the interviews and then having transcripts of the interviews prepared. Then the information was grouped into themes or topics. Figure 3.1 represents the approach taken as recommended by Ryan & Bernard (2010).

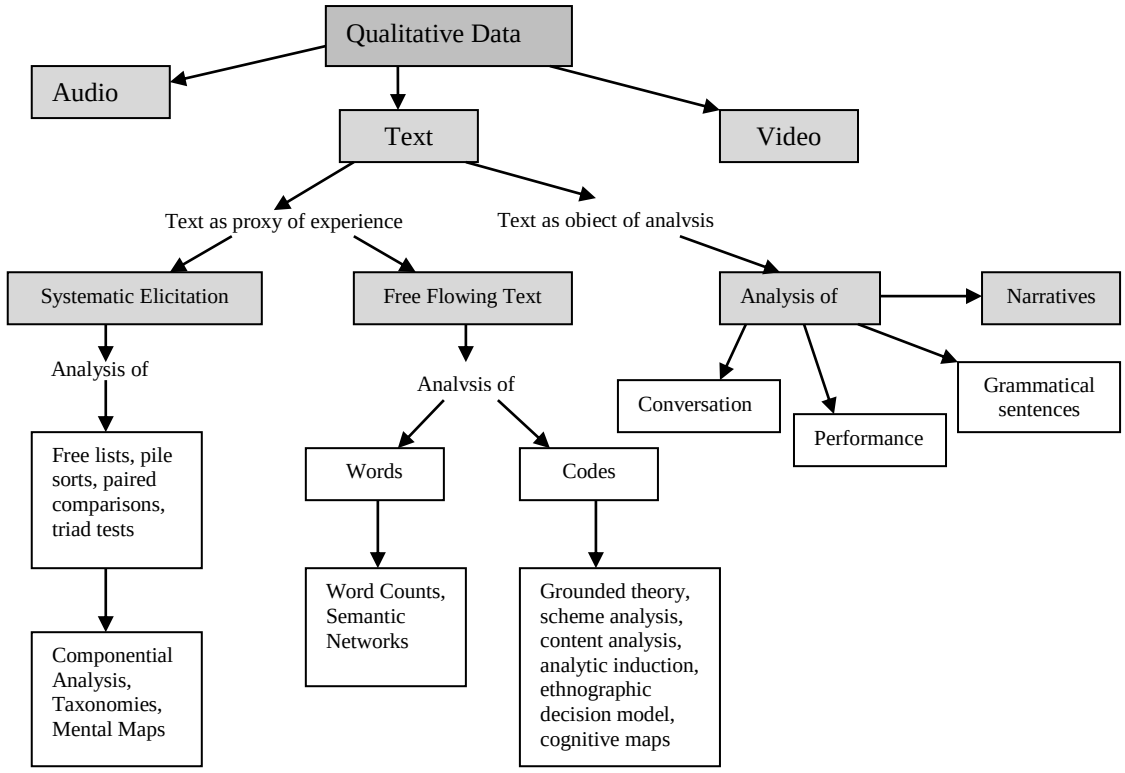


Figure 3.1: Typology of Qualitative Data Analysis

(Source: Ryan & Bernard, 2010)

3.3.5 Action Research

Action research is defined as a group of people who work together and are involved in planning, acting, observing and reflecting and producing a report on the experience (Altrichter, 1993). Action research is separated from traditional research in that it involves social systems of which the researcher is unavoidably a part. The researcher actively participates with others in the critical exploration of complex and dynamic issues, which relate to the relationships between people and their physical and socio-cultural environments (Bawden, 1991). This is the case with this study, the researcher is the manager of the area of study, safety, which is a complex and dynamic area strongly embedded in people and cultural issues. The practical applications presented in Chapter 6 are the core of this research and are action research based.

3.4 Research Design

A research design was developed using three phases combined into an overall research design which informs this study as previously presented in Figure 1.1 (Shown here again as Figure 3.2 on page 83). The three phases form the research requirements of the qualification of the Doctorate of Business Administration. Phase one is a literature review that was conducted to scope the research question and investigate the safety and knowledge management fields, this literature review was updated and revisited throughout the study. Phase two consists of an exploratory analysis based on two case studies which incorporated field work and an organisational context into the study. In addition phase two developed a preliminary conceptual framework. Phase three consisted of two climate studies and a series of practical applications. The first climate study was used to establish a base line and benchmark to test the research question and the second climate survey to measure the improvement three years later. Between the climate surveys, 16 practical applications were implemented which applied knowledge management principles to safety management. At the completion of all three phases the research question was revisited and appropriately discussed.

3.4.1 Literature Review

An extensive literature review was conducted to better understand the fields of safety management and knowledge management to determine the direction of this study. It was used to formulate the research question for which this study is based. The literature review is contained in Chapter 2.

3.4.2 Exploratory Analysis

Much of the earlier literature on knowledge management focused more on "learning organisations". The following definition by Farrell (2000:32), used for learning organisations, is closely linked to knowledge identifies:

"Organisational learning occurs with an organisation skilled at creating, acquiring, and transferring knowledge, and at modifying its behaviour to reflect new knowledge and insights".

A case study approach was used for the exploratory analysis because of the strengths identified by Eisenhardt (1989). Case studies are useful for problem definition and construct validation;

the research approach is especially appropriate in new research areas or research areas for which existing theory seems inadequate; in early stages of research on a topic or when a fresh perspective is needed.

The exploratory analysis of Phase 2 involved two case studies within a large Australian manufacturing organisation, Pilkington Australia Pty. Ltd. The reason for the choice of the organisation was that manufacturing is still seen as the primary area for safety focus as employees are exposed to a great risk and the interaction between person and plant is prevalent. As noted in section 1.5, the manufacturing industry still has by far the highest number of serious non-fatal injuries. Within the manufacturing industry, the manufacture of glass and its associated handling is a high risk, high volume environment, making it a good candidate for this safety research. The two case studies were investigated to determine a series of findings or guidelines that then could be used to implement learning organisation concepts and hence the application of knowledge management within an organisation.

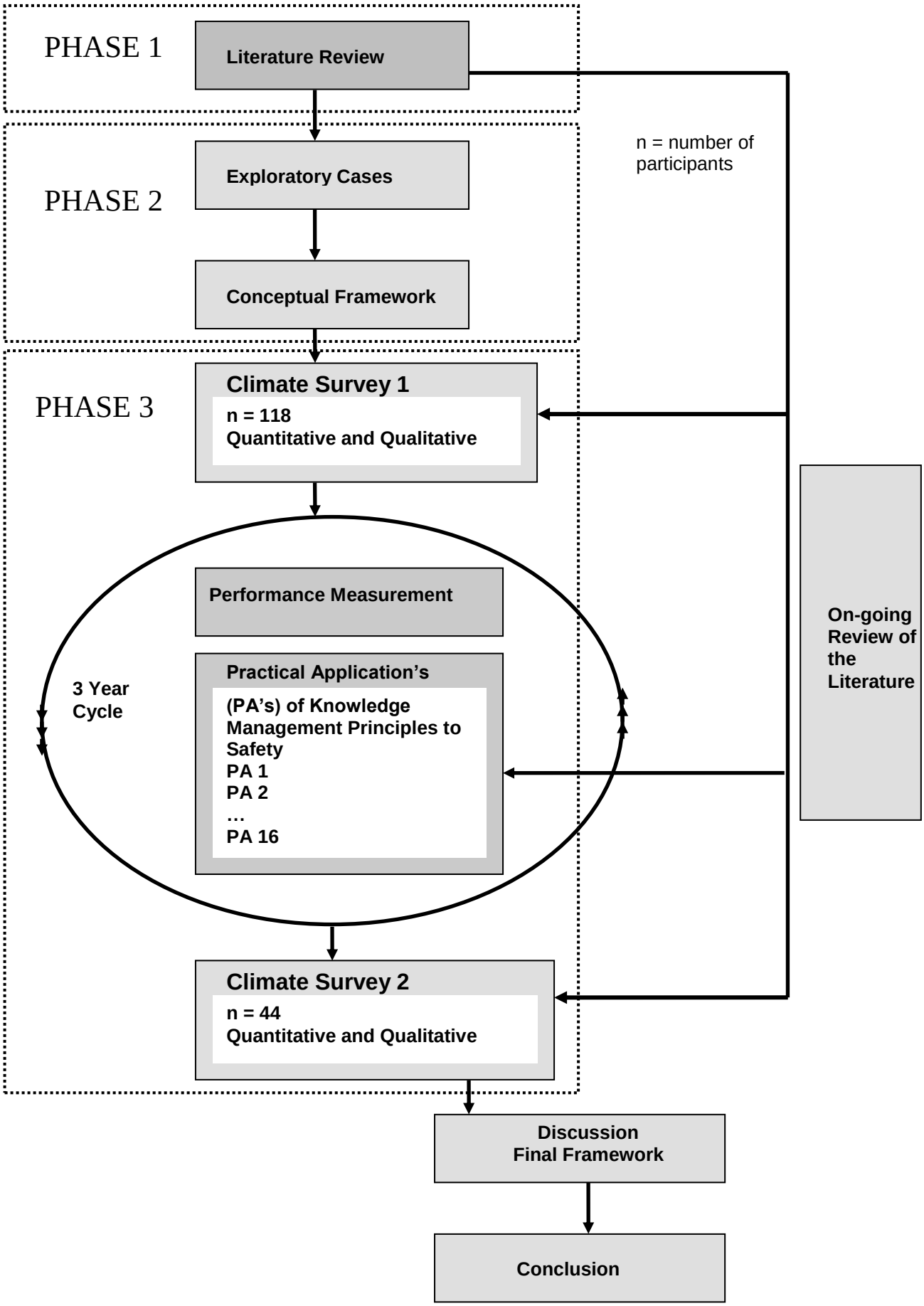


Figure 3.2 Research Design

The first case study involved with the disposal and cost of industry waste which is both an environment and safety issue. It investigated how knowledge management was used to develop a solution to the problem.

The second case study was involved with the management of a significant safety issue associated with carcinogenic substances and associated costs. Again it explored how knowledge management was applied to the situation and used to develop a solution.

3.4.3 Development of the Initial Conceptual Framework

The results of the two case studies conducted at Pilkington were used to develop some initial concepts on knowledge management with respect to safety. The literature reviewed identified frameworks that were either focused on safety management or knowledge management. Examples of safety frameworks which incorporate knowledge management includes Griffin and Neil (2000) but no knowledge management frameworks exist that include safety. Based on both of these approaches, a preliminary conceptual framework was developed. This is based on work by Schwandt and Marquardt (2000). It forms the theoretical framework behind the practical applications applied in Phase 2 and covered in chapter 6..

At the completion of the practical applications and after reviewing additional literature, the conceptual framework was modified. The final framework for the application of knowledge management principles to safety is presented in Chapter 8 (see Figure 8.1).

3.4.4 Major case study organisation – Visy Industries

Visy is a large multinational manufacturing organisation within Australia, with over 5,000 employees and 2,000 contractors working on over 100 sites ranging from a billion dollar paper mill in NSW with over 300 employees to a small recycling facility with 5 employees in far north Queensland. It's operations cover heavy and light manufacturing, marketing, research, logistics & transport, recycling and printing operations. Visy has an annual turnover of approximately $2 billion dollars. Hence, although this study is focused on one organisation, it has implications in many industries and sectors beyond the specific study.

Safety performance in Visy up until the start of this study (2005) has been ordinary or average, the lost time injury rate of 23 is a lot higher than many of its counterparts in the similar industry (Reputex, 2005). There has been many approaches to safety within the company in the past but they were very much plant or division focused. There were pockets of excellence within the company but they were not utilized and divested for maximum gain across the whole company. However, the concept of knowledge management was new and not understood very well in the company. Hence, when this study was introduced to the company, it was more under a safety strategy and climate surveys rather than the application of knowledge management. This allowed greater ease in implementation and support. The next step in the study was the establishment of a benchmark to measure future improvement.

3.4.5 Climate Surveys

Two climate surveys were carried out as part of this study incorporated into Phase 3. The first was carried out (in 2005) in order to establish a benchmark to measure future performance and to establish initial recommendations to improve the Visy organisation from an Occupational Health and Safety perspective. The second survey was carried out in 2008 after the completion of the practical applications. Many researchers in the safety field use a questionnaire to evaluate safety culture or climate (Burke et al., 2002; Griffin & Neil, 2000; Shannon, Mayr & Haines, 1997; Silva, Lima & Baptista, 2003). They use questionnaires because they allow for the consistent collation of information with controlled responses for easier analysis. This made it appropriate to develop a safety questionnaire to establish the safety climate in Visy. The questionnaire was divided into four main sections namely; safety climate, safety commitment, safety capabilities and engagement in safety activities. The questionnaires are contained in Appendix 5.1 and 7.1. The second questionnaire was slightly changed due the changes in organisational structure and requirements from the organisation.

Section one of the questionnaire was developed from common best practice approaches with regards to safety climate (Cheyne, Oliver, Tomas, & Cox, 2002; Guldenmund, 2000; Mearns, Whitaker & Flin, 2003; Griffin & Neil, 2000). There were 27 questions in total which covered five key themes: safety management, safety standards, safety communication, responsibility for safety and safety training. The questions were mixed and some repeated with slightly changed wording for greater reliability and integrity (Patton, 2005). For each question a common Likert type scale is used (Likert, 1932), however to avoid a middle ground response using a 1-5 scale

it was reduced to a 1-4 scale (1 being strongly agree and 4 being strongly disagree). This forced the respondent to give an objective answer rather than a neutral one.

Section two of the questionnaire was designed to define safety commitment. For this, a similar approach to safety climate was used, however rather than using a level of agreement, a level of commitment was used: 1 being uncommitted and 4 being extremely committed. The respondent was asked to evaluate their perception of each level of the organisation: themselves, senior management, plant management and employees in general.

Section three of the questionnaire was designed to gauge an understanding of the capabilities of the employees in the organisation. That is, whether they were capable of performing critical safety functions. As Kennedy and Kirwin (1995) has identified, it is how the policies and procedures are implemented in the workplace, how it is physically managed and hence how the activities are undertaken that determine safety performance. Individuals (safety professionals and management) should have the capability to perform the necessary activities. A series of closed questions were included to determine whether or not the respondent felt they were capable of performing a safety activity.

The final part of the questionnaire (section four) was designed to evaluate the actual engagement of the respondents in safety activities. As Mearns et al., (2003) asserts, the actual safety management practices that take place and associated activities is what has the greatest impact on safety performance. Hence, a series of questions were asked to determine which key safety activities listed in the questionnaire had the respondent actually undertaken over the last six months. This period was chosen as it is the continuous application and improvement of safety which is a critical driver to safety improvement.

Recognising the limitations of quantitative data, the Climate Surveys also included a set of qualitative questions to provide further insights and to enable validation of the results of the quantitative data. Ten open ended, short answer, questions were included covering strategy, barriers to improvement, behaviours and activities, safety standards, training, legislation, physical risks, areas for improvement and resources. These were developed by reviewing the main components of safety systems and by consultation with safety professionals. The consultation consisted of phone conversations and two meetings with each of the six divisional safety representatives to ensure the right aspects of a safety system were covered.

Mail surveys typically result in response rates of 10% to 20% (Ticehurst & Veal, 2005). This would be insufficient for this study given the sample of respondents that could be included for the study. Across the 106 Visy plants, 44 Safety Professionals (or "contacts" as some were nominated for the role but not qualified) and 260 managers were available for inclusion in this study. A telephone survey was considered more appropriate since both quantitative and qualitative data was being collected. The phone survey gave a much higher response rate then a mail survey. It also allowed for results to be more accurate as the person on the phone could clarify the response. Finally, a phone survey allowed for better exploration and response to the short answer questions, which often give a poor response in mail surveys (Rea and Parker, 2012). The resources available, geographical spread of respondents and time constraint also justified the use of a telephone compared with face-to-face interviews for professionals and executives, this approach is supported by Anseel et al. (2010) and Moser & Kalton (1979).

The questionnaire was targeted at safety professionals and top and middle management since these individuals are the key drivers of change within the plants. Safety professionals in particular provide the support and the tools to ensure that safety activities take place (Baer & Frese, 2003, Burman & Evan, 2008, Pidgeon & O'Leary, 2000). An organisational announcement was made declaring a focus on safety and that a survey is to be carried out, all endorsed by the CEO. For Climate Survey I, all of the 44 safety professionals were included in the survey. Of the 260 managers, 84 were randomly selected for inclusion in the survey. The respondents could refuse to take part and it was made very clear that participation was voluntary and all information was confidential. The letter sent to participants requesting their participation is presented in Appendix 5.2. Forty-two of the 44 safety professionals and 76 of the 84 managers eventually participated in the telephone survey. All phone surveys (also referred to as interviews) were recorded on tape and transcribed to improve the integrity of the data and assist in further analysis, covered in more detail in chapter 5, Climate Survey I.

For Climate Survey II, a smaller sample size was selected for a few reasons. Since the Climate Survey I was conducted, the organisation structure had changed significantly with a dramatic reduction in the number of top and middle management. The six divisions had been consolidated into four and the number of top executives had reduced from 40 down to 18. Essentially the same process was followed as with Climate Survey I (Project 1). Of the 21 safety professionals targeted, 19 participated in the survey whilst of the 25 managers targeted,

23 participated. Climate Survey II was again given endorsement by senior management. There were some changes to the questions due to changes in organisational requirements. Improvements in the organisation since climate survey I was conducted is covered in more detail in chapter 7.

3.4.6 Practical Applications

The core of Phase 3 was where a series of practical applications were applied in the field of safety using knowledge management principles. These practical applications were designed and implemented in an action research type approach as defined by Bawden (1991). There were 16 different applications in all covering a range of safety principles for which knowledge techniques were applied in accordance with the conceptual framework. They were:

1. Legislation and Regulations
2. Safety Leadership and Culture
3. Safety Strategy and Action Plans
4. Risk Analysis and Hierarchy
5. Safety Systems
6. Employee Consultation
7. Behaviour Based Safety
8. Work Environment
9. Injury Notification
10. Incident/Accident Investigation
11. Safety Training
12. Auditing and Compliance
13. Measurement and Statistics
14. Injury Management
15. Health and Wellbeing
16. Off-the-job Health and Safety

Due to the time required to plan and implement these applications in practice, they were conducted over a period of three years. Using the action research methodology, there was a review of literature throughout these applications. The steps for each practical application principally undertaken were as follows:

1. ***Research*** – A knowledge management principle is identified, eg. "Networking to share knowledge in an organisation"
2. ***Framework*** – Identify where the principles sits in the overall framework, eg. Networking comes under tacit knowledge.
3. ***Application*** – Identify how the knowledge principle can be applied to safety practically, eg. A network meeting of safety professionals in the organisation.
4. ***Plan*** – gain funding and support for the application in practice.
5. ***Implement*** – carry out the knowledge management principle as it applies to safety, eg. the network meeting in practice with agenda and scope.
6. ***Observe*** – study the process and outcomes taking place in practice, eg. gather feedback and outcomes of the network meeting. This may involve the analysis of safety performance and improvement.
7. ***Reflect*** – reflect on the whole practical application and all preceding steps to look for improvement to apply further in practice, this feeds into the research and starts the process again.

Also, in line with the action research based approach, the applications and effectiveness was tested through performance measurement which ran for the duration of the study.

3.4.7 Performance Measurement

Performance measurement for safety varies greatly in industry and is a key area for safety professionals (Toellner, 2001). A total of 14 performance measures were used in this study, as discussed below. A significant issue in safety is the lack of consistent measurement, this has been identified by Bottomley (2003) and there is only one Australian Standard that tries to address this, AS 1885.1 – 1990, The Workplace Injury and Disease Recording standard. This standard, as it states, is used for consistency of compensation based statistics, hence it has information relating to the details after an injury has occurred. The most common measure which is widely used in industry is the Lost Time Injury, and hence this is the first measure used in this study:

1. *Lost Time Injury rate – defined as the number of full days lost for an injury per million hours worked.*

Performance measurement needs to cover the more proactive, safety activities that actually are required for legislative and safety compliance. A range of proactive safety measures were chosen which covers the core legal requirements or stipulations of most occupational health and safety legislation (Verhagen, 2001). These measures covered risk assessment, risk control, training and supervision. Based on the requirements of the organisation (Visy) and for more practical reasons, the following measures were chosen in this regard:

1. *The actual number of risk assessments completed by site.*
2. *For risk control, the safety actions completed by site (workplace audits help to maintain risk controls as well).*
3. *For training, the number of toolbox talks completed by site.*
4. *For supervision, the number of workplace audits completed.*
5. *Incident investigations, which has a specific legal requirement with respect to injury notification.*

With respect to a proactive or a leading indicator for injury management, early intervention can be driven by early reporting of injuries as identified by Isernhagen (1991). Further, to measure the performance on injury management it is also necessary to examine those on restricted duties or at home full-time, due to their injuries. Hence, the next three measures included are:

6. *On time reporting of injuries, that is, injuries reported within 24 hours that may potentially result in lost time.*
7. *Employees on restricted duties but still at work.*
8. *Employees not at work due to a work related injury.*

To better represent all injuries, not just those resulting in lost time, other minor injuries also need to be captured for a more complete picture of injuries. Hence, the following two measures were included:

9. *Major injury frequency rate (Lost Time Injuries and Medically Treated Injuries)*
10. *All injury frequency rate (Lost Time, Medical and First Aid Injuries).*

To help improve commitment of senior management and to minimise direct safety costs, the following two measures relating to workers compensation were also included:

11. *Workers compensation premium cost per employee.*
12. *Workers compensation claims costs per employee.*

Upon review of all the measures there was one key measurement missing and that was the actual severity of an incident. A lost time injury could result in one day off work or as many as 200 days off work, however, this is classified as one lost time injury. Hence, a final measure chosen was the number of hours lost per injury reported in the incident recording database:

13. Severity rate, the number of hours lost per an injury reported.

These 14 performance measures were used to assess the safety performance during the practical applications over the three years of this study.

For each site, data was collected each month on these 14 performance measures and then accumulated by division and then collated as a whole to measure the company performance. This was based on using a balanced scorecard type approach (See chapter 2.2.3.13). Proactive measures or leading indicators, such as risk assessments completed are entered into a database each month by the nominated site representatives. Injury statistics, such as lost time injuries, are gathered from a centralized incident reporting database. Workers compensation statistics, such as, workers compensation claims costs per employee, are taken from the organisations' insurer. Injury management statistics, such as on-time reporting of injuries, are taken from the outsourced injury management provider who manages this process and had a 1300 call number for the reporting of injuries.

3.5 Assessing the quality and rigor of the research

There is often criticism around the rigour of research in the social sciences and how conclusions can be inferred from a limited scope of information and analysis (Anfara et al., 2002; Mentzer & Flint, 1997). As suggested by Denzin & Lincoln (2000), a number of criteria can be used to improve the quality and rigor of social research by addressing/considering credibility, transferability, dependability and conformability. These are discussed below. Also, as noted earlier, based on methodical triangulation, this research involved both qualitative and quantitative research within a longitudinal study, which provided measurable, tangible results adding to the rigor and quality of the research.

3.5.1 Credibility

Credibility can be considered in two aspects. Firstly, in terms of those performing the research their skills and credibility in the field studied, and secondly, the credibility of the actual

research itself. The researcher has over 20 years' experience in the field of study working for several different companies in Australia, USA and the United Kingdom. He holds a Masters of Engineering degree in Quality Management and has presented at several national conferences. Before starting the research component of the DBA degree, the researcher completed subjects on qualitative and quantitative research methods.

Credibility in terms of research is a measure of the "trustworthiness of inferences drawn from data" (Anfara et al., 2002). Several strategies were used to improve the credibility of the research. Firstly, the research involved methodical triangulation of both qualitative and quantitative data as noted. Secondly, the qualitative data is from primary and secondary data sources. Thirdly, being a longitudinal study conducted over three years, there is prolonged engagement in the field. Fourthly, there was performance measurement within the study through the performance assessment and participant feedback. Fifthly, the data collected was analysed using statistical techniques (eg. T-test) to determine whether a significant improvement in safety had taken place in the organisation. Finally, using an action research based approach, modifications and improvements were implemented in the case study organisation leading to positive outcomes for the management and employees at each site.

3.5.2 Transferability

With respect to the ability to transfer the outcomes of the research to other organisations and industries both nationally and internationally, there are a number of points to note. Indeed, this detailed research was only carried out in two organisations. However, the main organisation involved in this research is a large multinational, and hence, has a broad range of activities and operates across several industries. Industry sectors covered by the organisations include: light manufacturing, chemical processes, heavy manufacturing, transport, logistics, office environments, recycling, hazardous facilities, utilities, research, marketing and investment. Also, the principle field of safety is applied commonly across industries and there is only one safety legislation in the state of Victoria regardless of the industry. Similar legislation exists in all other territories and states in Australia. Indeed there is a national push to having one legislation across Australia which has been mandated by many states as of December 2012. The practical applications studied can be applied to any industry, both nationally and internationally. Indeed the practical applications come from British, Australian and USA guidelines and standards. Also, as the fields are applied in the behaviour sciences, it can be

more easily transferred across industries, that is, safety is concerned with the health and welfare of workers regardless of what environment they work in. Simply, the risks may vary in scale and complexity but the management principles are common.

3.5.3 Dependability

Dependability of the results was improved by using several sources of data as noted below:

- Questionnaire surveys
- Third party insurer data
- Third party injury management data
- Records and transcripts of interviews with managers and employees
- Incident recording databases

As well as these several sources of data, there was also a statistical analysis for significance using the t-test of difference in means of an irregular sample size. This analysis of quantitative data was done using a statistical software package (SPSS) and the qualitative data was analysed using N-vivo to obtain key phrases and words in the first climate survey and results used also in the second climate survey. See chapter 7 for more details of the statistical analysis.

3.5.4 Conformability

Conformability was achieved through triangulation as noted and supported by Anfara et al., (2002). The action research based approach in the practical applications also provided the ability to regularly reflect on the process. A number of the telephone questionnaire surveys for both Climate Survey I and II were completed by appropriately trained research assistants at Monash University Australia who were provided with a dialogue or run sheet to work from, explaining the study and purpose to each participant before asking for approval (See Appendix 5.2). As noted earlier, all interviews were transcribed for analysis.

3.5.5 Ethical issues

There are ethical considerations in this research to be considered since they involve human subjects that make up an organisation (Ticehurst & Veal, 2005):

1. *Those involved in the research should have a level of competence and knowledge in the subject* - In response to this, the main researcher in this study has over 20 years of

experience in the field and is guided by highly qualified and experienced academic professionals.

2. *Any study should involve a detailed literature review to ensure prior work has not been covered* - This review is presented in chapter 2.
3. *The use of data and information without acknowledgement is another common issue* - This is not the case in this study as the study is based on the organisations involved and is primary data gathered for this study.
4. *The results must not be falsified or changed from their original source* - In this case as all data is included in the appendices and was transcribed from tape recordings.
5. *Subjects should be provided the option to participate without any prejudice or recourse* - To this end participants were provided the option to participate and approval was obtained (See Appendix 5.2). Ethical clearance was also obtained from Monash University Australia ethics committee for this study.

Hence, this research does address all the ethical issues that are raised by Ticehurst and Veal (2005).

3.6 Summary of Chapter 3

This chapter described the research design and methodology. Firstly, this chapter summarised research in the safety and knowledge management fields and their origins in management research. The limitations in existing research was identified and based on this a research design was developed for this research to overcome these. A research design was developed using all three phases from the DBA criteria and incorporated into an overall research study by incorporating literature reviews, preliminary analysis, a conceptual framework, discussion and conclusion. The methodology chosen involved a range of techniques to help overcome limitations identified in previous research also. Ranging from quantitative, qualitative analysis, methodical triangulation, longitudinal, case study and questionnaire techniques. These were incorporated into an action research based approach involving practical applications as the core. Finally, this chapter covered the quality and rigor of the research. The subsequent chapters are aligned with the research design, beginning with the Exploratory Phase as the major literature review has been covered in chapter 2.

CHAPTER 4

RESULTS OF EXPLORATORY CASE STUDIES AND PRELIMINARY FRAMEWORK

4.1 Introduction

This chapter presents the results of two exploratory case studies and the development of the preliminary framework used to test the research question. As a new approach to safety is examined using knowledge management principles, a case study approach was used. This is supported by Eisenhardt (1989) who advocates that case study research be used in such circumstances. In section 4.2 the case studies are established first by introduction to the area and then the chosen organisation and finally the two cases are examined to then establish a set of principles. Then, in section 4.3 these were incorporated into an initial framework and by revisiting the literature with this objective in mind. This is achieved by examining what models exist in safety management and knowledge management respectively and then developing a combined model for which the case studies findings could be incorporated.

4.2 Exploratory Case Studies

This section describes two projects (case studies) undertaken by a large manufacturing organisation (Pilkington Australia Ltd.) that involved significant change in 2004. Although these studies were done over 10 years ago to establish a grounding for the study, the knowledge and conclusions still apply to this day and the key concepts obtained have been applied to several organisations since. Section 4.2.4 provides some more recent examples from 2012-13. The aim was to identify the key concepts that were critical in the completion of the two projects and discuss how these relate to a learning organisation and knowledge management. Action research is the approach adopted in this part of the study.

4.2.1 Company Background

Pilkington Australia Ltd. (now part of CSR Australia) was a subsidiary of Pilkington Inc. which is a global float glass manufacturer based in the U.K.. Pilkington Inc. (2004) had 26,500

employees globally with an annual turnover of 2.8 billion pounds. Pilkington Australia Ltd. (PAL) had 42 sites and 2,050 employees across Australia and New Zealand with its head office based in Dandenong, Victoria. PAL consisted of three main production sites that supply to 39 downstream processing and retail sites. Of the three core sites, Dandenong (Victoria) was the largest site employing 310 employees. PAL was the market leader and holds over 70% of the Australia and New Zealand float glass market with annual revenues of about $400 million and was the only company that manufactures glass in Australia, the remaining 30% was made up of imports by competitors.

The Dandenong plant was built in 1967 to cater for the growing demand for float glass in the region. The operations are highly capital intensive, with over $140 million invested in capital equipment on the site. The main float process is highly automated employing 56 people with the rest being in processing operations. The plant runs 24 hours a day, 7 days a week. Major restructuring had taken place in recent years to lift the company to profitability from increasing losses in the past. The site had gone from 610 employees in 1994 to 310 employees in 2004 with investment in automation, moving operations downstream and outsourcing of non-core activities. The workforce was multicultural of moderate intelligence with many years of experience in the operations as identified by an average service of 12 years. A strong industrial culture existed at the three major production sites.

In the two case studies presented below, the actual project undertaken is described. The learning from these projects in terms of knowledge management is discussed in section 4.2.4.

4.2.2 Case Study 1: Waste Reduction

Heavy manufacturing produces a large amount of waste and PAL was no exception. Each year thousands of tonnes of waste go to landfill and waste recycling facilities. By far the most environmentally damaging of these wastes is ‘prescribed waste’, as identified by the Environment Protection Authority (EPA) who determines the list of prescribed waste. Prescribed waste is of particular concern to the government not just because of the damage to the environment and possible long term human effects. Also because the Victorian state has insufficient sites to handle such waste and the availability of suitable sites is diminishing, hence the costs of disposing of such waste is dramatically increasing. During 2002, the Dandenong site produced over 660 tonnes of prescribed waste costing over $112,000 (not including

transport costs). As a consequence, PAL was on the EPA Focus 30 list of worst polluters in the state.

On the site the waste comes from two main sources; waste batch and mirror cullet. Waste batch is the mixture of raw materials that go into making the glass that have been mixed incorrectly due to many process issues. Mirror cullet is broken up mirror glass as a result of process rejects and faults. PAL is always looking for ways of reducing this waste and there have been opportunities to reduce the source of this waste. The greatest opportunity came when an employee attended a local conference on environmental management. One of the segments was on recycling and it alerted to a list of waste recyclers that could be used to recycle industrial waste that was available on the internet Sustainable Energy Authority website. On returning to the site, the employee saw an opportunity to recycle some of the prescribed waste through a recycler. A presentation was made to management and upon endorsement, a project team was set up consisting of Purchasing, Environment and Production employees. The team organised for four local recyclers to visit the site and view the waste to determine if there were any opportunities to recycle some of the waste.

The company that offered the best means of recycling the most amount of waste was the Alex Fraser Group (AFG), a supplier of materials to the construction industry. AFG identified that the waste batch could be used as a road base material or in concrete and that the waste mirror could be crushed up and also used in another layer of the road base.

To allow the waste to be recycled it required approval from the Environmental Protection Authority (EPA) to ensure that the waste was not harmful to the environment in its end use. This involved extensive testing and reports of the processes and uses which the project team organised with the Alex Fraser Group. Once the approval was received from the EPA, all of the waste batch and mirror cullet could be recycled. There were issues with respect to transport and storage, such as dust release, that the team had to overcome. This initiative reduced the prescribed waste from the site by 98%, amounting to a saving of over $150,000 per year that was expected to be much greater in the years to follow. The lessons learnt from this case study are discussed in section 4.2.4.

The project team efforts were recognised by the EPA and PAL in that the company was no longer on the top 30 list of worst polluters. PAL was presented with an award by the state minister on behalf of the EPA for its achievements.

4.2.3 Case Study 2: Carcinogenic Substances

The manufacture of glass requires high temperatures for which specialised insulating material is used. In order to maintain the thermal properties, these materials are usually carcinogenic and hazardous. The insulating material is applied around the seals to the furnace used to manufacture the glass. In the past, materials such as asbestos were used and these have long been replaced by lesser carcinogenic materials. Based on the Material Safety Data Sheet (2004) the material being used was Fibrefrax that is a level 2b carcinogen, a carcinogen that has never been recorded to have affected humans but has been shown to be carcinogenic in high doses in laboratory experiments on rats. Due to its hazardous nature many controls and procedures have been put in place. Every time the material has to be replaced or access gained in the vicinity of the material, complete coveralls and masks need to be worn by the operators. However, sometimes due to the emergency of the situation in the process, access needs to be gained quickly and complete sets of clothing need to be replaced to ensure the carcinogen is not transferred to an uncontrolled environment. The hazardous nature of the material and administrative controls had caused many industrial and downtime issues. This amounts to a very costly and time consuming part of the process with many associated safety issues.

PAL is always trying to find ways to improve safety by reducing hazardous materials wherever possible. However, in this case it was thought that a lesser hazardous situation could be achieved. It was believed by the union that there might be some materials that could be developed for this particular application and that it should be researched. Again, this was presented to management through the local safety committee. A project team was set up consisting of operators, safety professionals and process experts to develop a better solution to the carcinogenic material problem.

The project team searched extensively throughout Pilkington, its supplier base and similar industries. An extensive Internet search was also conducted to see what materials were available. Three different materials were considered based on an analysis of their chemical

properties and applications. However, one material stood out because it was not carcinogenic at all and it was also non-hazardous. Hence, there was no need to wear protective outfits and other controls associated with a carcinogen. There were some concerns about whether the material would be suitable for the process and the specific insulation requirements. Nevertheless a comprehensive testing and trial period began involving a laboratory analysis of the material to ensure it maintained its properties during application and to monitor the process parameters.

The initial trials were successful and more material was ordered and more tests were carried out to ensure full confidence in the replacement product. At all times extensive notes and communication took place with all parties concerned to assist in adoption and acceptance. The project was a great success and not only greatly improved safety and communication but also a saving of over $40,000 per year. The team was recognised by senior management of PAL and rewarded for their efforts in the form of gift vouchers and formal recognition.

4.2.4 Discussion of exploratory case study findings

In this section ten key concepts that were critical to developing and completing the two case study projects described in the previous section are explained. These can be considered core principles of a learning organisation and use the principles of knowledge management. The ten concepts discussed below are:

1. Expand capabilities of the workplace
2. Utilising resources internal and external
3. Create entrepreneurial activity in the workplace
4. Gain enthusiasm and drive support
5. Time for reflection and learning as part of regular work
6. Set up horizontal teams in the organisation
7. Risk identification and analysis
8. Problem solving skills and expertise
9. Focus on value adding activities but consider the ‘big picture’
10. Recognition and reward.

1. Expand capabilities of the workplace

A key part of a learning organisation is the creation of knowledge by expanding the capabilities of the employees within the workplace. The concept of knowledge and its continuous creation is vital to the survival of the organisation (Morton, 1998, Schwandt & Marquardt, 2000). However, companies such as 3M recognise the limits of formal training programs to achieve this, and has built a major part of its knowledge development into the day-to-day operations of the organisation (Ghoshal & Bartlett, 1998). Important to the development of capabilities is the support and motivation of management of the need to do so. In leading organisations, senior managers spent a substantial amount of time and energy developing the individual members of their organisations. Also, in supporting their ideas and initiatives, middle managers have a key role in facilitating the process of organisational knowledge creation (Ghoshal & Bartlett, 1998, Morton, 1998).

"They (business leaders) want not only to increase their own capabilities, but improve the capabilities of the other people around them. They recognise that an organisation develops along with its people." (Senge, 1990:124)

Dr. Yoshiro Maruta, CEO of Kao Corporation describes his organisation as 'an educational institution' rather than a corporation. Maruta insists that 'learning is a frame of mind, a daily matter.' Thanks largely to its institutionalised knowledge-building capability to develop individuals, Kao Corporation has become universally recognised as one of the most consistently innovative companies in Japan (Ghoshal & Bartlett, 1998). Anderson Consulting strives to have at least three staff attend seminars and conferences identified as valuable by the firm (Schwandt & Marquardt, 2000). Companies must recognise that in a learning organisation, diversity of perspectives, experiences, and capabilities can become an important organisational asset and must be expanded and developed (Ghoshal & Bartlett, 1998). In case study 1 capabilities were expanded by having employees attend appropriate conferences whilst in case study 2 capabilities were expanded by allowing research into Pilkington world-wide, it's suppliers and other companies. In a more recent application of expanding the capabilities of a workplace at Yooralla, a large not-for-profit organisation, staff were given the opportunity to do further postgraduate studies in safety which they were not offered before. The outcome is that the project work undertaken on risk management as part of these studies has redesigned the

risk management approach at Yooralla and greatly improved compliance and client outcomes in reducing manual handling incidents.

2. Utilising internal and external resources

Lean manufacturing organisations, such as Pilkington, realise they cannot maintain all the resources internally and remain competitive and hence must utilise external resources whilst maximising the knowledge of internal resources. The use of partnerships and joint ventures as organisational actions can increase the amount and quality of new information that is available to the organisation (Schwandt & Marquardt, 2000). Business leaders can help support this by creating a climate for maximising resources by developing community partnerships, improving business representation and networking structures (Morton, 1998). Then to quickly diffuse the information and knowledge gained so it can be leveraged by the entire organisation (Ghoshal & Bartlett, 1998). Where possible, the sharing of ideas should be done on a face-to-face basis creating a higher openness/trust and information sharing (Alge, Wiethoff & Klein, 2003). In case study 1, the resources available from the Environmental Protection Authority and, the Sustainable Energy Authority were utilized. In addition, the internet was used extensively. In case study 2 suppliers were used to develop alternative materials and the operators from the production line were involved rather than external consultants. In a more recent application of utilising internal and external resources at Yooralla an OHS Advisory committee has been established which connects not-for-profit organisations to share ideas and approaches. One such example is the use of a telephone injury report line which has reduced paperwork and administration for staff and managers.

3. Create entrepreneurial activity in the workplace

Today, there is an almost universal recognition that the vast majority of the world's largest and most powerful organisations have lost much of the entrepreneurial spark and individual initiative that made them successful in the first place (Ghoshal & Bartlett, 1998). This is not the case for leading organisations such as 3M and ABB whose most striking set of activities and achievements common to their frontline entrepreneurs were those related to their willingness and ability to create and pursue new opportunities (Ghoshal & Bartlett, 1998). Nurturing innovation and entrepreneurial activity in order to foster an environment that inspires others to

deal creatively with business and people problems is critical, thus ensuring continuous renewal of the learning organisation (Ghoshal & Bartlett, 1998, Schwandt & Marquardt, 2000). In case study 1, entrepreneurial activity was generated in the skills and knowledge of the supply department and the Health, Safety and Environment department and their ability to apply it to a workplace application. In case study 2, entrepreneurial activity was created by allowing the operators to take ownership of the projects through the allocation of time and resources. In a more recent application of entrepreneurial activity in the workplace (at Yooralla), the creation of three high risk projects in connection with manual handling, occupational violence and slips/trips/falls risks are being managed by key staff in teams to come up with solutions.

4. Gain enthusiasm and drive support

In order for any initiative to eventuate in an organisation it must gain the support and enthusiasm of the leaders which is cascaded through the organisation as the following explains:

"It is the liberating and energizing element … that raises individual aspiration levels and encourages people to lift their expectations of themselves and others" (Ghoshal & Bartlett, 1998:82).

In case study 1, enthusiasm and support was gained through the identification of the improvements that can be made in the workplace and having staff with the correct knowledge and ability involved in the project. In case study 2, employee enthusiasm was created by involving only those individuals (unions and safety representatives) who had a particular interest in the area and had relevant experience. Management support was gained by ensuring that only those managers with sufficient authority in the company were involved. Their involvement ensured allocation of adequate resources to the project. In a more recent application of gaining enthusiasm and driving support is the creation in Yooralla of a consultative approach to auditing which requires the auditor to show how they can help a site or location than just a policeman like approach from a checklist.

5. Time for reflection and learning as part of regular work

Organisations need to stimulate employees to reengage in learning, bringing with them their prior knowledge. Reflecting on the learning, evaluating, and giving and receiving feedback on what they are doing and learning is also important. This ensures a greater depth of learning, enabling learners to think strategically, plan and monitor their activities in ways that promotes further learning (Cullen, 1999, Schwandt & Marquardt, 2000). In both cases the reflection and learning was a part of the whole process as there were regular reviews and meetings towards a defined target and changes made as the projects progressed. For the recycling program (case study 1) evidence of this was in the way in which the process for capturing the waste was modified to enable easier transport. In a more recent application of time for reflection and learning at Yooralla a mindfulness program has been run which has shown success in improving client outcomes.

6. Set up horizontal teams in the organisation

To maximise the knowledge and benefits of learning in an organisation, horizontal linkages amongst peers are strengthened through a variety of mechanisms, including industry and functional specialist networks (such as EPA), as well as strong firm-wide norms (Ghoshal & Bartlett, 1998). That in turn requires people to voluntarily seek and provide assistance to colleagues. Unless people talk and share it with peers, knowledge remains untapped (Desouza, 2003). This is another way for organisations to expand capabilities by forming partnerships and linking the information from each individual into a common information system that can be used by all the partners (Schwandt & Marquardt, 2000). As it is through social networks within manufacturing operations that engineering/technical staff and operational employees engage in learning within their communities of practice (Griggs & Hyland, 2003). This allows individuals to learn through exposure to experts in their environment, an interactive process within which people work collectively on a problem in an effective manner (Cullen, 1999). Hence the set-up of horizontal teams in the organisation allows the linking of dispersed knowledge, skills, and best practices across units (Ghoshal & Bartlett, 1998). In case study 1, the horizontal team consisted of employees from Supply, Health, Safety and Environment, Engineering and Waste Recyclers bringing all the skills required to solve and disperse the learning. In case study 2, the horizontal team consisted of employees from Production, Health, Safety and Environment,

Engineering, Material Suppliers (Alex Frazer Group) and the EPA, which was more focused on internal learning, problem solving and the dissemination of knowledge. In a more recent application of setting up horizontal teams at Yooralla within the People and Culture area, project teams have been set up with staff from different levels and areas of the organisation - not just subject matter experts. This has created new and innovative approaches to previous problems and issues.

7. Risk Identification and Analysis

A learning organisation is one where people are excited in trying out new ideas by taking risks and recognising that failure is an important part of success (Ho, 1999). In this environment managers support staff development, encourage risk taking and share insights and innovations (Farrell, 2000). Thus providing the resources and credibility to take risks and make the investments that stimulate the learning process (Ghoshal & Bartlett, 1998). In case study 1, risks included high levels of contaminated waste, non-approval by relevant authorities, difficulties with transportation and high set-up costs. In case study 2, risks identified included availability of appropriate materials, risks associated with using new materials, process problems introduced and excessive cost of the new materials. In each case study the end result was successful, positive outcome. However, all these risks had to be appropriately considered or addressed by the team. In a more recent application (2013) of risk identification and analysis was the risk program noted earlier at Yooralla which enabled a more sound and evidence based analysis which has been applied across the whole organisation.

8. Problem solving skills and expertise

Problem solving skills and expertise are required in order to make success of difficult situations and eliminate risks that may arise. This is emphasised in the action learning philosophy which is a dynamic process that involves a small group of people solving real problems while at the same time focusing on what they are learning and how their learning can benefit each group member and the organisation as a whole. It is built on the application of new questions to existing knowledge, as well as a reflection on actions taken during and after the problem-solving sessions (Schwandt & Marquardt, 2000). In case study 1, problem solving skills were

needed to resolve the risks identified in point 7 above. It was the skills and expertise of the cross-functional team that came up with answers. In case study 2, problem solving skills and expertise were introduced into the project through involvement of the engineering and HSE departments. In a more recent application of problem solving skills and expertise at Yooralla there is now a root cause analysis training element included in all induction sessions for new staff to improve their follow up and resolution of client and staff incidents.

9. Focus on value adding activities but consider the 'big picture'

The objective of a company is to capture as much as possible of the value that is embedded in its products and services (Ghoshal & Bartlett, 1998). This is achieved by ensuring that the learning and knowledge proves itself in action (Schwandt & Marquardt, 2000). However, focus needs to remain on the "big picture" of the organisation. Royal Dutch Shell (RDS) was identified as a learning organisation in the 1980's and recognised during the first half of 1990s as the world's leading oil company. However, in 1998, RDS posted a large loss. This was believed to be in part because the impact of learning in RDS could only become beneficial for the organisation when both management and employees combine not only for a shared vision but also organisational commitment and community (Quinlan & Bohle, 2010). Simply put, each employee must understand that the whole purpose of the organisation is to create superior value for customers. Further, a learning orientation can lead an organisation astray if a strong market orientation is not present to provide grounding (Farrell, 2000). In case study 1, the value adding was rather apparent from the start relating to the amount of waste and the associated disposal costs. The 'big picture' is introduced by also considering the waste to the community as a whole as the manufactured wastes are from non-renewable resources. In case study 2, the value adding was not as obvious, consideration had to be provided to the "big picture" of total costs and potential long term health effects rather than just direct savings.

In a more recent application of value adding activities, within the not-for-profit section of disability services, the National Disability Insurance Scheme (NDIS), has forced companies to look at the individual level of client-based value adding activities. In the past, this was a block-based, govern-funded program, not individual.

10. Recognition and reward

The purpose of recognition and reward is to "Get as many people inside (the organisation) who are as enthusiastic about the idea (learning organisation) as can be" (Mahoney, 2000:24). Recognition and rewards can drive and stimulate the learning organisation ethic that drives further improvement. In case study 1, the recognition was in the form of an award from the EPA presented to those involved in an award presentation. In case study 2, the recognition and reward was a presentation to key internal and external people and a gift provided to all those in the team by the manager of the area which improved morale across the workforce (based on positive feedback from other employees).

In a more recent application of recognition and reward at Yooralla, there is the annual media awards that the organisation provides, this now includes a comprehensive program to recognise staff contribution and service, such as the outstanding client service award.

4.2.5 Conclusion of Exploratory Case Studies

A learning organisation is one that can harness the power of its greatest asset, that is, the knowledge of its people. Not only using that knowledge but also developing and enriching it for the benefit of the whole organisation. This chapter provided two real life practical examples of how the theory of knowledge management can be applied to safety in practice in a lean manufacturing environment and in more recent examples in a large not-for-profit organisation in disability services, Yooralla. Then key concepts were identified and discussed in section 4.2.4. They can be applied in other situations and organisations to enhance knowledge management and develop a learning organisation. Using the safety knowledge framework as developed in the next section we see how the principles developed in this work can be applied. It is shown in the Figure 4.1 on the next page, where the numbers refer to the ten concepts discussed in the previous section.

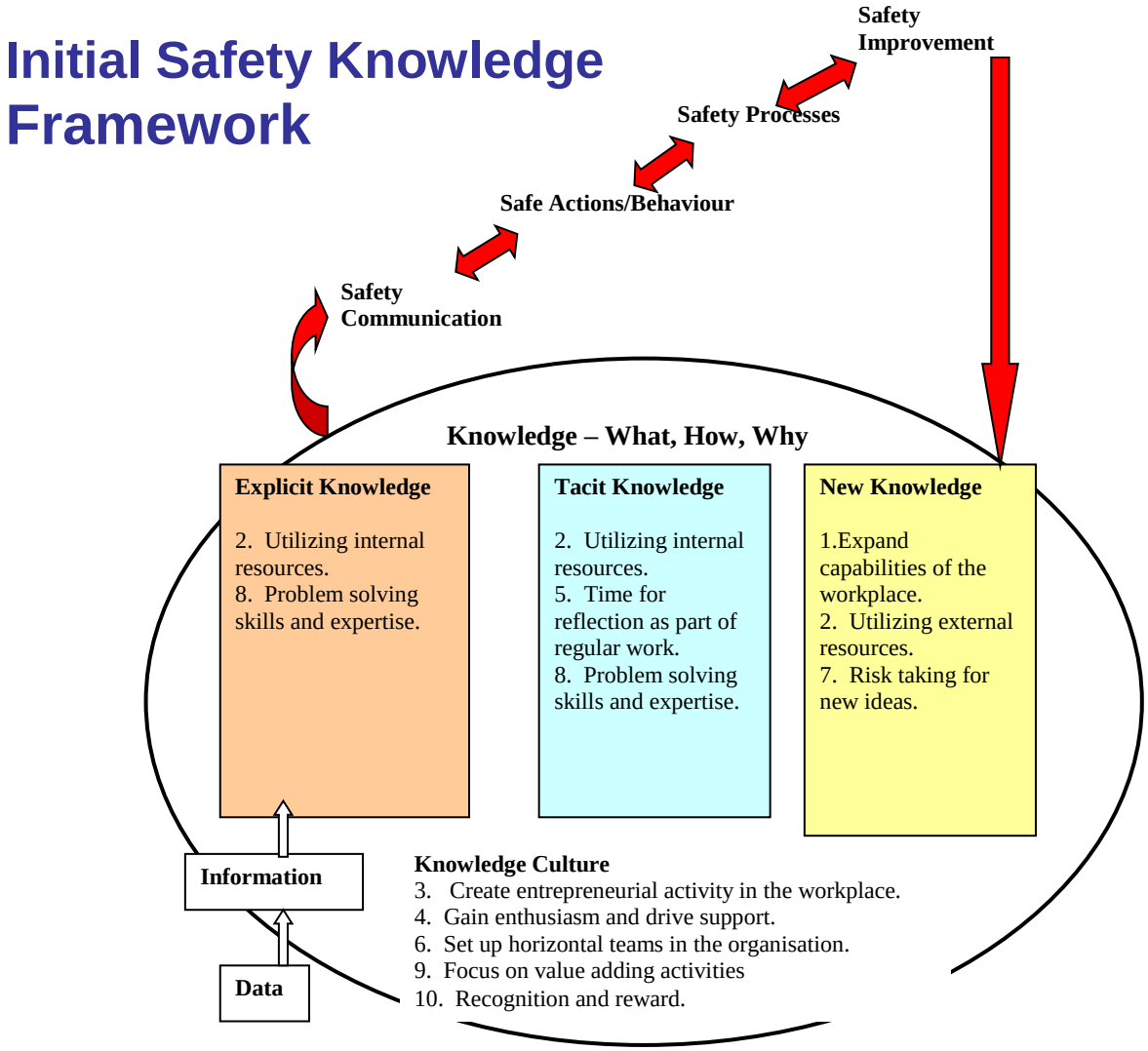
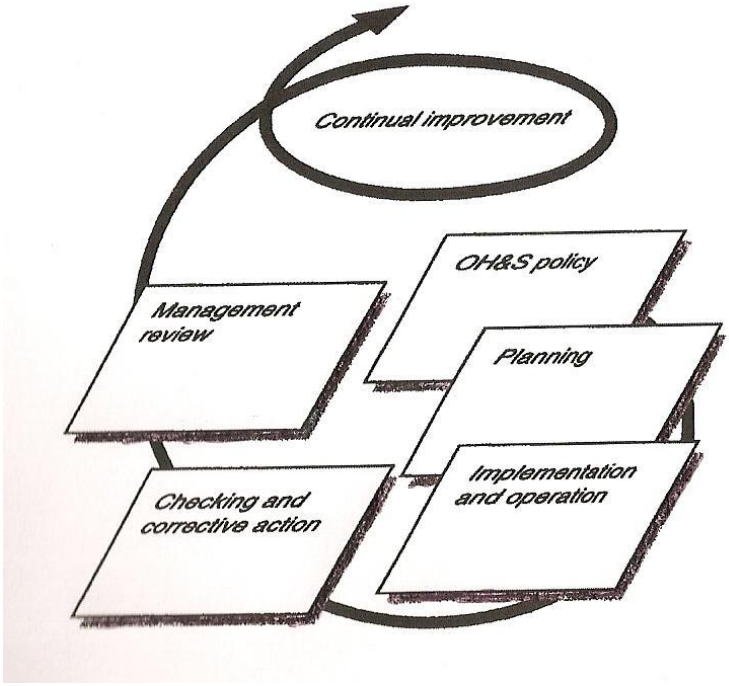


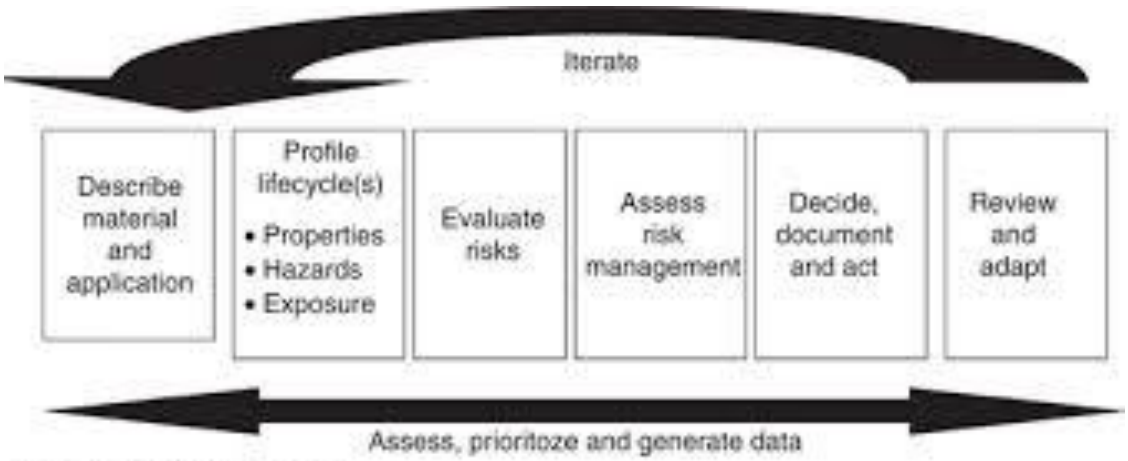
Figure 4.1: Initial Safety Knowledge Framework for preliminary analysis

4.3 Developing the Preliminary Framework

4.3.1 Safety Frameworks

There are a few frameworks in the literature with respect to safety management. Typically they are focused towards a safety system or standard. The most common framework used in Australia is the Australian Standard for safety (AS/NZS 4801:2001, see Figure 4.2) which is based on the simple continuous improvement cycle of Plan, Do, Check and Act, also shown in an example from Dupont (2007). There are other similar variations based on work in the quality area by Deming (1986).





Source: ED-DuPont (2007)

Figure 4.2 Improvement Cycle in AS/NZS4801:2001 and Dupont (2007).

The Australian Safety Standard and the Dupont model presented above reflects the action research based approach used in this thesis, which adds a more research-based element, see Figure 4.3 (Bawden (1991) in Zuber-Skerritt & Perry, 2002).

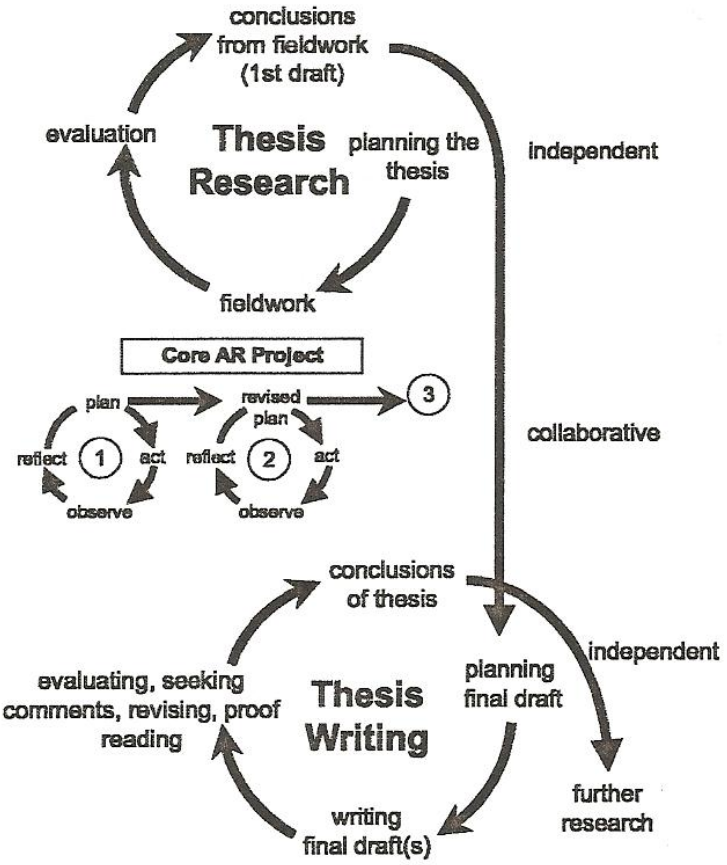


Figure 4.3: Action Research Model

(Source: Bawden (1991) in Zuber-Skerritt & Perry (2002))

The issue with these basic models is that they provide a 'concept' but do not go far enough to actually instil a system or process. Hence, as follow-on for complex processes such as safety, which are influenced by beliefs, behaviours and values, a more knowledge based approach can add to the rigor and content required to bridge the gap between the basic concepts and a sustainable framework. Safety systems make an attempt to bridge the gap between the continuous improvement cycle and safety in practice. Hence, there are a number of safety systems used in practice including the Australian Standard AS4801, British Standard BS8800, the 5 Star Safety System (from the National Safety Council of Australia) and the USA OSHA guidelines. These are briefly discussed below.

The AS4801: 2004 has the following seven system elements:

1. *General Requirements*
2. *OHS Policy*
3. *Planning*
4. *Planning, identification of hazards, hazard/risk assessment and control*
    i. *Legal and other requirements*
    ii. *Objectives and Targets*
    iii. *OHS Management plans*
5. *Implementation*
    i. *Structure and responsibility*
    ii. *Training and competency*
    iii. *Consultation, communication and reporting*
    iv. *Documentation*
    v. *Document and data control*
    vi. *Hazard identification, hazard/risk assessment and control of hazards/risks*
    vii. *Emergency preparedness and response*
6. *Measurement and evaluation*
    i. *Monitoring and measurement*
    ii. *Incident investigation, corrective and preventive action*
    iii. *Records and record management*
    iv. *OHSMS Audit*
7. *Management Review*

Occupational Health and Safety Systems included in the British standard, BS 18004 (2008) and BIP 3094:2013 (The OHSAS Standards and Guidance Collection) has the following elements:

1. *General*
2. *OHS Policy*
3. *Planning*
4. *Implementation and Operation*
5. *Checking*

Another widely recognised system is the "5 Star" safety system by the National Safety Council of Australia (NSCA). The NSCA 5 Star system covers the following elements:

1. *Policy*
2. *Organisation and Program Management*
3. *Management of Health and Safety Risks*
4. *Control of Specific Work Risks*
5. *Work Environment Issues*
6. *Emergency Preparedness and Management*

Another, more government originated system, is SafetyMAP (Safety Management Achievement Program) developed by the Victorian Worksafe Authority. The SafetyMAP criteria is divided into twelve elements as shown in Table 4.1.

	Element	Sub elements
1	Building & Sustaining Commitment	An endorsed health and safety policy statement Management responsibility and accountability Defined and communicated health and safety responsibilities Scheduled reviews of policies and procedures Employee involvement and consultation Issue/dispute resolution
2	Document the Strategy	Identification of hazards and assessment of risks Hierarchical risk control A strategic health and safety plan Manuals and other documents Access to relevant health and safety legislation and other information
3	Contract Review and Design Control	Consideration of health and safety at tender development and submission stage Incorporation of health and safety in design
4	Document Control	Systematic development, identification and distribution of health and safety documents Systematic removal from circulation of obsolete documents
5	Purchasing & Control of Product	Incorporation of health and safety into purchasing of both goods and services Verification that goods and services meet specified parameters Products used in the production process are identifiable Products produced are traceable
6	Management of the Work Process	Workplace and task design that minimises risk Safe work practices and workplace controls Workplace environmental controls Effective selection and supervision of employees Effective procedures for maintenance, cleaning, repair and inspection of plant and equipment Emergency plans and procedures First aid and critical incident response
7	Monitoring Standards	Health and safety inspection in the workplace Work environmental monitoring Integrity of testing equipment Health surveillance
8	Reporting & Correcting Deficiencies	Hazard reporting Incident reporting Incident investigation and remedial action
9	Managing Movement and Materials	Safe transport and storage of materials Hazardous substances controls Identification of materials (including hazardous substances)
10	Collecting & Using Data	Systematic data and record collection and maintenance Analysis of data and publication of reports on health and safety performance
11	Auditing of Management Systems	Auditing of the health and safety management systems Reporting deficiencies and reviews of suggested improvements
12	Developing Skills & Competencies	Planning of human resource development in health and safety Health and safety training for management, supervisors and employees Health and safety induction for employees, visitors and contractors

Table 4.1: Safety MAP criteria

(Source: Victorian Worksafe website, www.vic.gov.worksafe.com.au)

In the USA the OSHA Process Safety Management Guidelines are as follows (www.osha.gov):

- *Process Safety Information*
- *Employee Participation*
- *Process Hazard Analysis*
- *Operating Procedures*
- *Training*
- *Contractors*
- *Pre-Start up Safety Review*
- *Mechanical Integrity*
- *Hot Work Permits*
- *Management of Change*
- *Incident Investigation*
- *Emergency Planning and Response*
- *Compliance Audits*
- *Trade Secrets*
- *References*

It is argued by the author that there are some issues with the existing standards and the criteria. Firstly, the existing standards are not as holistic as the full definition of safety which now encompasses areas such as Health and Wellbeing, Injury Management and Workers Compensation. These all appear to exist outside of the safety standards, not integrated. Secondly, such standards are often too broad for the specific risks that need to be addressed in organisations, particularly large organisations that end up developing their own safety standards more tailored to the specific business requirements and risks. This concurs with the comments by Gallagher, Underhill & Rimmer (2001) that also state that many large organisations create their own safety systems and standards for this reason.

4.3.2 Knowledge Management Frameworks

It is believed that many of these approaches become self-perpetuating in their own right. As with the quality movement, many organisations have failed with their quality improvement programs because of implementation problems and the follow through to knowledge creation and dissemination. Firstly, consider the following definitions as defined in the literature in chapter 2, with respect to safety and knowledge:

Data: Is the primary source that can be used as the raw information. For safety it is the records; incident data, injury rates, workers compensation costs, hazard reports etc.

Information: Is the data that has been processed or manipulated to get a result or explore an outcome. For safety, it is the system and processes; incident reports, risk assessments, workplace audits, system audits, safety alerts, news feeds etc. It can also be considered a close link to explicit knowledge with respect to safety.

Knowledge: It is the information that has been transferred into action in the workplace. For safety, it is the actions from incident reports, the action plans from risk assessments, and the improvements to be made in workplace audits. Even more deeply, it is the information that has been processed in people's heads that influences them to act in a certain way, which is the tacit knowledge. Such as the knowledge that if a worker knows that if he does not wear a safety harness he can have a high risk of falling from height.

Many of the earlier safety standards address the first two aspects, data and information but not necessarily knowledge, which this researcher argues is most critical to safety. Standards and processes are not effective unless they create the knowledge in an individual to take action and to act more safely in the work environment.

Hence, to be more effective in safety, one can consider the application of knowledge management to safety to improve the safety outcomes as a 'safety knowledge framework'. To do this the knowledge literature needs to be examined to determine what model in knowledge management would be most appropriate to apply to safety. Thus, showing the link between safety frameworks and knowledge frameworks.

One of the most basic knowledge management frameworks or models is based on explicit and tacit knowledge, known as the knowledge creation spiral by Nonaka and Takeuchi (1995) shown in Figure 4.4.

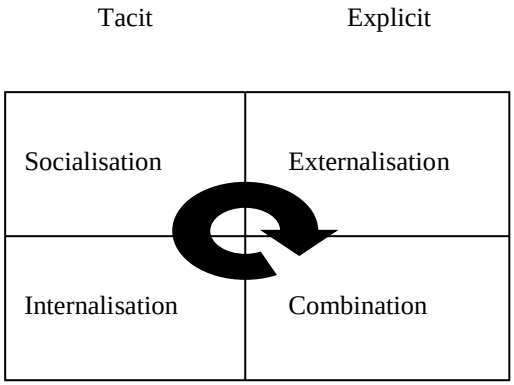


Figure 4.4: Knowledge creation spiral
(Source: Nonaka & Takeuchi, 1995)

The important aspect introduced by this model is that knowledge cannot only be defined in documents but needs to be transferred through social aspects. This is a major flaw in many safety standards and frameworks. The knowledge creation spiral introduces the social aspects for the transfer of tacit knowledge. The concern with such models is that they are difficult to test in practice and are often qualitative and interpretive. The resulting framework is more descriptive rather than prescriptive. Hence, it does still lack the sufficient detail and context to apply safety management and leads more to the continuous improvement cycle as noted earlier.

With respect to safety, a more action research type approach is needed, with more detail and the dynamic nature of knowledge transfer. The activity based model of Engestrom (1987) comes closer to the more action-based approach required to bridge the link with safety. Engestrom's cycle of expansive learning is represented in Figure 4.5. Again, this leads us to the more descriptive version of the Deming PDCA cycle.

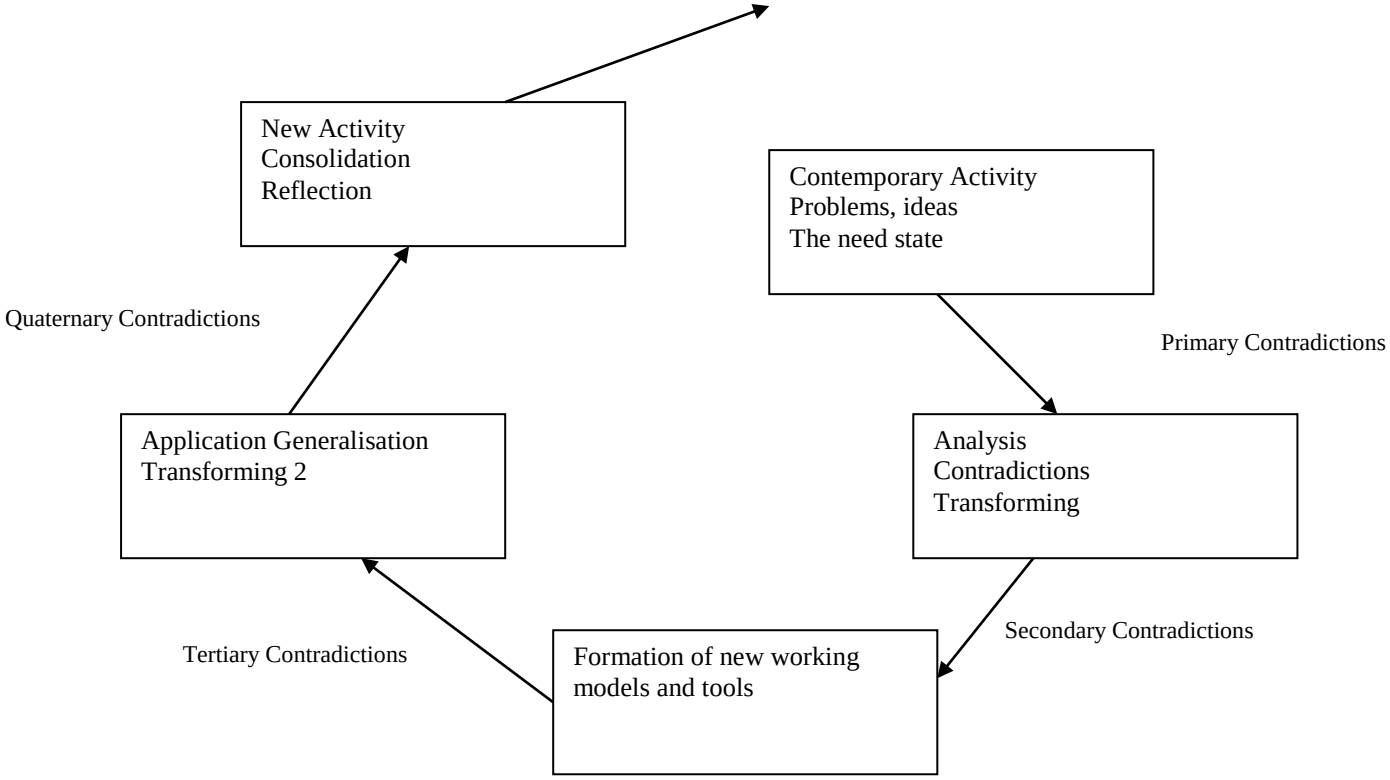


Figure 4.5: Cycle of Expansive Learning

(Source: Engestrom, 1987)

Again, the more prescriptive approach can be found in the Australian Standards, introduced in 2004 (AS5037 – Knowledge Management – a guide (AS5037)). The integrated knowledge management framework introduced in this standard is shown in Figure 4.6.

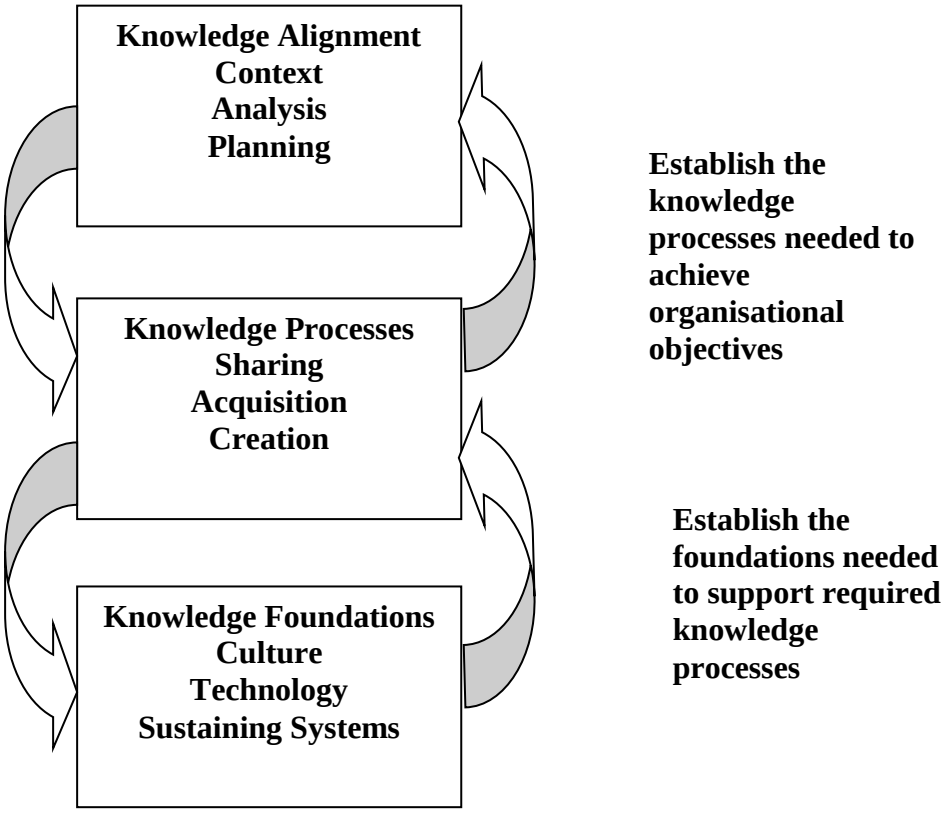


Figure 4.6: The Knowledge Management Framework

(Source: Standard Australia, 2003)

This framework improves on previous models as it introduces both a descriptive approach with respect to continuous interaction and prescription in terms of key aspects. However, it does move away from the continuous spiral of improvement which is necessary for safety, an even more prescriptive approach can be found in Dixon's (2000 and 2012) work which concentrates on the specifics of knowledge transfer and can be applied to the safety field. Of particular value in Dixon's approach is the practical application of the work which has been applied in many industries and companies, this is covered in more detail later in chapter 8.

4.3.3 Safety Knowledge Framework

With respect to a safety and knowledge framework, the work by Griffin and Neil (2000) can be a good starting point as it provides the critical link of knowledge with respect to safety climate and performance (see Figure 4.7). However, it does not integrate the in-depth knowledge management cycle and processes as the models in Figures 4.5, 4.6 and 4.7 do.

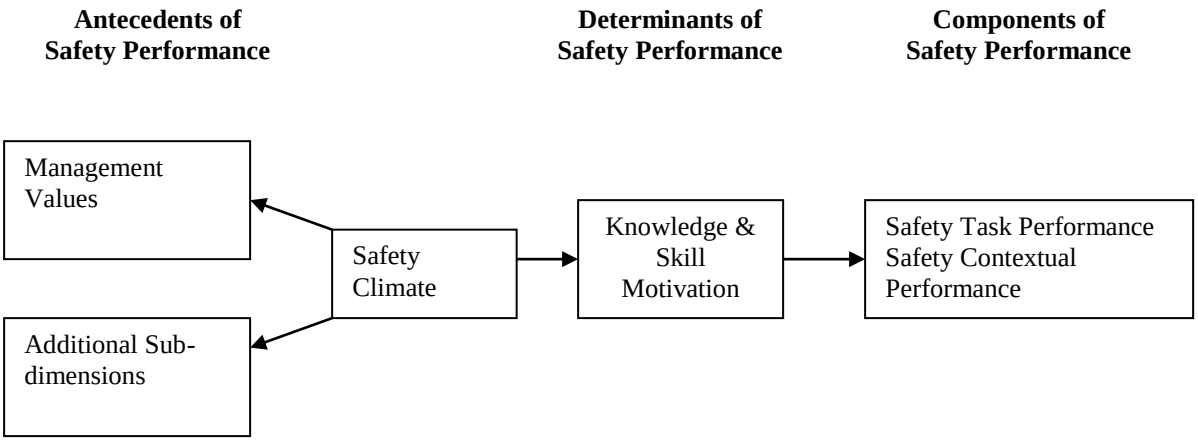


Figure 4.7: Safety Climate and Safety Performance

(Source: Griffin & Neil (2000))

A safety knowledge management framework is needed that combines the continuous improvement cycle of Deming or Engestrom's cycle of expansive learning with the prescriptive requirements of the Australian standard and the practical applications of Dixon (2000 and 2012). A proposed model is represented in Figure 4.8. It represents a safety knowledge framework that can be used to apply the knowledge management principles in an organisation to improve safety. This framework forms the basis for the practical applications within the major part of this research which is described in chapter 6.

4.4 Summary of Chapter 4

In this chapter the two exploratory case studies were investigated to develop ten key concepts which use the principles of knowledge management. The first case study was involved with the disposal of hazardous waste and the second with the use of carcinogenic substances. These findings were then incorporated into a Safety Knowledge Framework. The second part of this chapter examines the safety and knowledge frameworks that exist in literature to develop a safety knowledge framework. The next chapter contains the results from the first climate survey which was used as a benchmark for which the framework can then be applied.

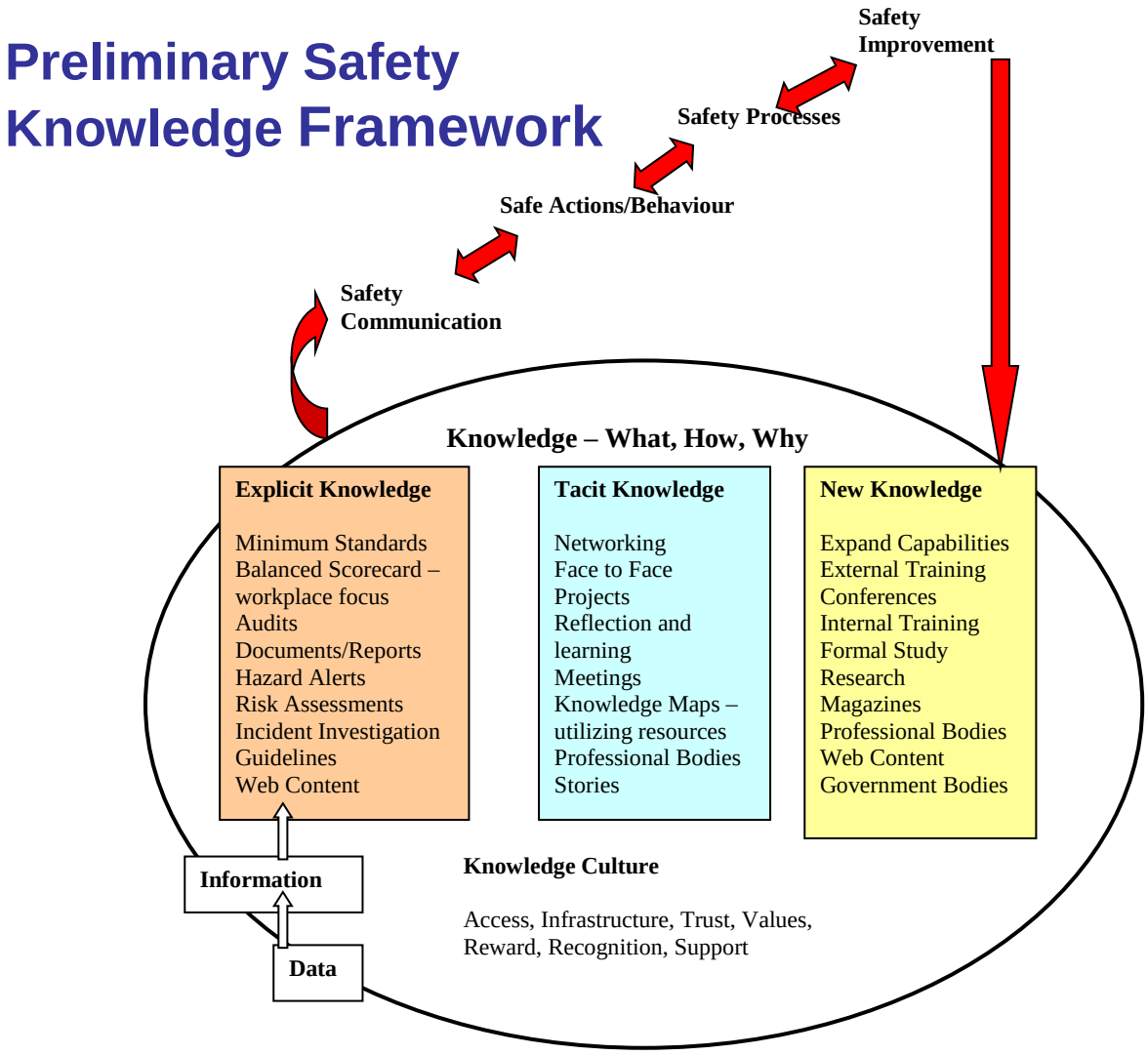


Figure 4.8: Preliminary Safety Knowledge Framework

CHAPTER 5

RESULTS OF CLIMATE SURVEY I

5.1 Introduction

The purpose this chapter with respect to the study was to establish a benchmark for which future improvement could be measured against. This can then be used to test the performance improvement in safety to test the research question of the study.

The aim of the first climate survey was to determine the state of safety within the various divisions of Visy (the major case study organisation), and to ascertain the levels of safety culture and commitment, safety capabilities and engagement in safety activities. This work would form the basis and benchmark for which a safety climate II could be measured against, three years later. Information was gathered through individual interviews with 120 managers and OHS professionals across Visy. The interviews were categorised into two separate components; quantitative and qualitative.

The quantitative component addressed issues such as safety climate, safety commitment, safety capabilities and engagement in safety activities. Safety climate data provides an overview of employee perceptions on safety specific issues, encountered on a daily basis. Safety climate provides a context in which employees assess the acceptability of their behaviour in relation to organisational safety expectations. Five safety climate themes were assessed in this component; safety management, safety standards, safety responsibility, safety communication and safety training.

The qualitative component of the survey requested information on a range of issues including the implementation of a new OHS strategy, the benefits and barriers to such implementation, future directions for improvement in OHS and OHS legislation.

5.2 Quantitative Discussion

The effectiveness of OHS systems depends in practice on the creation and maintenance of a robust OHS culture or climate in the workplace. Various Australian OHS Acts stress that the success of formal OHS management systems depend heavily on culture and politics within organisations and that OHS climate is a subset of an organisation's overall culture. Although the concept of OHS climate may lack some degree of intellectual rigour, it can be defined as a shared understanding within an organisation of the significance of OHS problems and the appropriateness of measures needed to engage them e.g. control, co-operation, communication and capability/competence (Waring, 1996).

Users of OHS survey tools report that, in large organisations particularly, it can present challenging findings to senior managers and as a result an opportunity for organisations to use them as a compliment to strategic direction and implementation (Barling, Kelloway & Iversion, 2003). It is also clear that OHS climate surveys can be a useful complement to formal auditing and can yield useful insights at a corporate level in terms of OHS management, accountability, communication and implementation (Hofmann & Morgeson, 1999).

The quantitative instrument utilised for this research were telephone interviews developed using OHS Best Practice principles and adapted to investigate the specific OHS needs of Visy Industries. The instrument is included in Appendix 5.1. The results presented in this section are dissected at the division level. Seven divisions are included; Specialties (n=15), Pulp and Paper (n=10), Visy Industrial Packaging (VIP) (n=17), Recycling (n=26), Visypak Beverages (n=15), Visypak Food (n=9) and Visy Board (n=15). The Executive group was also included in the study (n=11).

The structured questions reported on in the sub-sections below relate to safety climate, safety commitment, safety capabilities and engagement in safety activities.

5.2.1 Safety Climate

Respondents were probed on their attitudes, perceptions and behaviour on safety specific issues, encountered on a daily basis. Safety climate provides a context in which managers can assess the acceptability of their behaviour in relation to organisational safety expectations. This assessment covered five themes namely: safety management, safety standards, safety

responsibility, safety communication and safety training and are reported as an average score across several questions in each category.

The results for the Safety Climate dimensions dissected by division are presented in Table 5.1.

	DIVISION								
	Specialties (n=15)	**Pulp & Paper (n=10)**	**VIP (n=17)**	**Recycling (n=26)**	**Vispak Beverages (n=15)**	**Vispak Food (n=9)**	**Visy Board (n=15)**	**Executives (n=11)**	**Full Org. (n=120)**
	%	%	%	%	%	%	%	%	%
Safety climate									
Strongly disagree	-	-	-	-	-	-	-	-	-
Disagree	27	20	24	19	20	-	20	64	41
Agree	73	80	76	77	80	100	80	36	59
Strongly agree	-	-	-	4	-	-	-	-	
Safety management Strategies									
Strongly disagree	-	-	-	4	-	-	-	-	1
Disagree	27	20	13	4	7	11	13	46	18
Agree	73	70	71	85	93	89	80	54	77
Strongly agree	-	10	6	7	-	-	7	-	5
Safety standards									
Strongly disagree	-	-	-	-	-	-	-	-	-
Disagree	20	30	12	15	13	-	34	46	22
Agree	80	60	82	85	67	89	53	54	72
Strongly agree	-	10	6	-	20	11	13	-	7
Safety responsibility									
Strongly disagree	-	-	-	-	-	-	-	-	-
Disagree	13	20	12	8	7	-	7	18	11
Agree	67	60	71	73	86	67	80	73	72
Strongly agree	20	20	17	19	7	33	13	9	17
Safety communication									
Strongly disagree	-	-	6	-	-	-	-	-	1
Disagree	27	20	24	8	13	11	7	27	21
Agree	53	50	59	73	74	33	80	64	66
Strongly agree	20	30	11	19	13	56	13	9	13
Safety training									
Strongly disagree	20	-	-	15	-	-	-	18	8
Disagree	13	40	23	31	53	33	54	64	38
Agree	60	50	65	46	40	45	33	18	45
Strongly agree	7	10	12	8	7	22	13	-	9

Table 5.1: Safety Climate dimensions dissected by division – Climate Survey I

5.2.1.1 Overall Perception of Visy's Safety Climate

This dimension focused on the perception of safety climate. Overall, 41% of the respondents disagree that Visy has a strong safety climate. Comparing the differences between divisions, Visypak food rated the highest, indicating the highest perception of a strong safety climate, followed by Beverages and Pulp and Paper. Interestingly, these are three divisions that have invested more into their safety programs, in terms of resources and money, in recent years and hence it reflects in the results. Visypak Food in particular, where a major initiative launched by

the executive after a serious accident, including three new staff. Executives rated the lowest in this element, indicating that more work needs to be done at this level, this links to one of the recommendations noted later.

5.2.1.2 Safety Management Strategies

This theme assessed perceived effectiveness of safety management strategies. Overall 19% of the respondents disagreed with the effectiveness of safety management strategies either disagreeing (18%) or strongly disagreeing (1%). Analysing the differences between divisions, there is a high rating for safety management strategies across each division, Specialties being the lowest in the divisions with a total of 73% agreeing, perhaps due to the amount of change that has occurred in this division in recent years. Overall, again the lowest rating is amongst the executives with only 54% in agreement, indicating that either the executives are not involved or aware of the safety management strategies in their division or that they hold a much higher standard for this element.

5.2.1.3 Safety Standards

This theme assessed standards of performance and behaviour established and accepted within Visy. Overall 22% of the respondents perceived the safety standards within Visy to be disagreeable. Safety standards were lowest in VIP and Visy Board, indicating that these divisions are not satisfied with the safety standards in their division. There is quite a variance between divisions which needs to be addressed. Again, the executives rated this element as low, which is interesting considering that it is the leadership that can determine the safety standards in an organisation. Perhaps they are identifying that they need to do more work themselves, this is analysed further in the qualitative analysis in section 5.3.

5.2.1.4 Responsibility for Safety

This theme assessed perceived responsibility for safety, and whether respondents consider safety to be everyone's responsibility. The literature and industrial experience consistently highlights that a sense of responsibility for safety must be shared by all staff, before safely is practiced first. Overall, 11% of the respondents did not believe that safety was considered everyone's responsibility at Visy. Safety responsibility rated high across all divisions, over 80% agreeable in each, however Pulp and Paper had 20% disagreement, showing that there may be more of a demarcation issue in this division. Again, the executives rated low with 18% in disagreement, perhaps they felt that the responsibility could be delegated or they had high expectations.

5.2.1.5 Safety Communication

This theme assessed the extent to which OHS issues are communicated throughout the organisation. Overall, 22% of the respondents disagreed that the communication of information about occupational safety throughout Visy was acceptable. There is a significant disagreement of safety communication across the divisions with VIP, Specialties and Pulp and Paper recording 30%, 27% and 20% in disagreement respectively, that the safety communication is inadequate. However, Visy Board and Recycling has disagreements of only 7% and 8% respectively, indicating that communication is better in these divisions and that some of the techniques used in these could be used in other divisions. For example, Visy Board had a minute out for safety (stopped all machines across the country for one minute) to raise awareness. Visy Recycling had system training sessions and safety notice boards introduced at each site. Again, the executives had a low rating compared with the divisions, perhaps more communication is needed with the executive, this is explored in the recommendations.

5.2.1.6 Safety Training

This theme assessed the extent to which people receive training and its perceived effectiveness. Overall 46% (38% disagree and 8% strongly disagree) of the population did not believe that they received sufficient amounts of training and that the training provided was considered ineffective. Training was seen to be the lowest element across divisions as well, with some divisions like Recycling indicating training is poor, with 15% strongly disagreeing, this may be due to increased awareness that there are a significant amount of activities requiring the need for more training. Again, the executives rating the lowest in this element, indicating that executive safety training is needed, none had been done for a few years.

5.2.2 Safety Commitment

Perceived levels of safety commitment were assessed using a four question inquiry, namely; commitment toward OHS improvement, commitment of Visy senior management toward OHS improvement, commitment of plant managers and leaders toward OHS improvement, and commitment of Visy employees generally toward OHS improvement. Each respondent was asked to grade the perceived level of commitment according to a four point scale, namely; uncommitted, committed, moderately committed, extremely committed. The results for the Safety Commitment by Division are presented in Table 5.2.

	DIVISION								
	Specialties (n=15)	**Pulp & Paper (n=10)**	**VIP (n=17)**	**Recycling (n=26)**	**Vispak Beverages (n=15)**	**Vispak Food (n=9)**	**Visy Board (n=15)**	**Executives (n=11)**	**Full Org. (n=120)**
	%	%	%	%	%	%	%	%	%
My level of commitment to OHS									
Uncommitted	-	-	-	-	-	-	-	-	-
Committed	7	10	-	4	-	-	-	9	4
Moderately committed	27	30	47	15	40	22	20	36	28
Extremely committed	66	60	53	81	60	78	80	54	68
Senior managements' level of commitment to OHS									
Uncommitted	7	-	6	4	-	-	-	-	3
Committed	40	30	18	15	20	11	13	36	23
Moderately committed	40	30	41	50	40	22	47	46	41
Extremely committed	13	60	35	31	40	67	40	18	33
Plant managers' levels of commitment to OHS									
Uncommitted	-	-	-	4	-	-	-	-	1
Committed	27	20	12	4	20	11	27	36	18
Moderately committed	53	60	59	38	27	22	47	55	45
Extremely committed	20	20	39	54	53	67	26	9	36
Level of commitment to OHS in employee body									
Uncommitted	-	-	-	4	7	-	7	-	3
Committed	33	60	23	19	20	22	33	9	31
Moderately committed	60	30	65	69	60	22	67	55	53
Extremely committed	7	10	12	8	13	56	13	36	13

Table 5.2: Safety commitment by division – Climate Survey I

5.2.2.1 My level of commitment to OHS

With respect to their level of commitment to OHS, 96% of the respondents perceived themselves to be moderately (28%) or extremely committed (68%) to organisational safety. Analysing results across the divisions, high results were obtained in Visy Board, Food and Recycling with 80%, 78% and 81% being extremely committed, respectively. However, much lower results in other divisions with VIP being the lowest at only 53% extremely committed showing that consistency of commitment of individuals needs to improve. The executives were equal lowest showing that they felt they could improve themselves in commitment to safety.

5.2.2.2 Senior managements' level of commitment to OHS

When respondents were asked to describe the level of commitment of Visy senior management toward OHS, 3% of respondents perceived senior management to be uncommitted to occupational safety, and 23% of the respondents perceived senior management to be only committed. The lowest scores were in Specialties (7%), VIP (6%) and Recycling (4%), indicating that senior management in these divisions in particular need to demonstrate more commitment to safety to the employees. The executives rated better in this element than the

other divisions overall. However, the level of commitment could still improve significantly with only 18% indicating they were extremely committed.

5.2.2.3 Plant managers' level of commitment to OHS

When respondents were asked to describe the level of commitment of plant managers and leaders toward OHS improvement, significantly 18% of respondents perceived plant managers to be committed to safety while the majority (45%) perceived them to be only moderately committed. Although commitment levels across divisions were on the committed level, only Visypak Food showed a high rating for extremely committed, at 67%, indicating that this division has a high level of safety commitment amongst the plant managers. The executive managers rated the plant managers much lower than the divisions themselves (only 9% extremely committed), perhaps the executives are not as aware of the day-to-day activities that the plant managers are doing for safety.

5.2.2.4 Level of commitment to OHS in employee body

When respondents were asked to describe the level of commitment of Visy employees generally toward OHS improvement, the perceptions of managers and OHS professionals was that 3% of the employee group were perceived to be uncommitted while 53% were moderately committed and 13% were extremely committed. The results across divisions were similar, with the only exception again being Visypak Food with 56% in the extremely committed, indicating that if plant managers are committed as indicated in the previous question, often the employees are too. However this time the executives did rate the overall employee body as rather high with 36% extremely committed.

In summary, the respondent group of managers and OHS professionals did not perceive themselves as being highly committed to safety. The overwhelming impact of this is that all other employees will perceive management's commitment to safety and the employees as a group will have a correspondingly poor level of safety commitment. As will be seen in the next section, this has resulted in a lack of OHS engagement by employees and a reflection of mediocre OHS leadership and safety climate in general.

5.2.3 Safety Capabilities

The safety capabilities segment of the survey was designed to uncover the levels of confidence respondents had in undertaking various fundamental elements required of any OHS system or standard. The results (shown in Table 5.3) also provides the added insight as to whether OHS professionalism is being promoted amongst teams and individuals, the extent of OHS practices, and the adaptability of core management staff to working in teams with general staff members.

	DIVISION								
Capable of taking part in or conducting a:	**Specialties (n=15)**	**Pulp & Paper (n=10)**	**VIP (n=17)**	**Recycling (n=26)**	**Vispak Beverages (n=15)**	**Vispak Food (n=9)**	**Visy Board (n=15)**	**Executives (n=11)**	**Full Org. (n=120)**
	%Yes	%Yes	%Yes	%Yes	%Yes	%Yes	%Yes	%Yes	%Yes
Plant Risk Assessment	80	100	100	100	93	100	93	73	92
Chemical Risk Assessment	40	80	71	46	60	33	47	27	49
Safety Assessment	80	100	100	100	93	89	93	82	93
Accident Investigation	87	80	94	100	87	78	87	91	90
Workcover Review	93	90	77	88	87	100	100	91	90
Safety Initiative	100	90	100	100	100	89	93	100	97

Table 5.3: Safety capabilities dissected by division – Climate Survey I

5.2.3.1 Capable of taking part in or conducting a Plant Risk Assessment

Respondents were asked whether they were capable of taking part in a plant and equipment risk assessment. The overwhelming majority of respondents (92%) reported that they felt capable. The results across all divisions were high with the exception of Specialties, at 80%, although not real low, it indicates that more training on risk assessments is required in this division. Executives rated lowest at 73% indicating that they may require more training, however, they may see these duties lying on employees beneath them.

5.2.3.2 Capable of taking part in or conducting a Chemical Risk Assessment

Respondents were asked if they were capable of taking part in a chemical risk assessment. In this case only 51% of respondents felt they were capable, indicating perhaps a general uncertainty and familiarity with respect to the application of materials safety data. Visy Food, Specialties, Recycling and Board all rated below 50% in this capability indicating training on this aspect is particularly needed in these divisions, especially considering they all have

significant chemical risks on their sites. Again the executives rated the lowest, perhaps for the same reason as the previous element.

5.2.3.3 Capable of taking part in or conducting a Safety Assessment

Respondents were asked if they were capable of conducting a safety inspection. The overwhelming majority of respondents (93%) reported that they felt capable. Ratings across the divisions were consistently high, with the exception of Specialties again. The executives rated lower than most but at 82% it is still a good result at this level of the organisation.

5.2.3.4 Capable of taking part in or conducting an Accident Investigation

Respondents were asked if they were capable of conducting an accident investigation of any medical or lost time injury. The overwhelming majority of respondents (90%) reported that they felt capable. Visy Food and Pulp and Paper were the lowest between divisions at 78% and 80% being capable respectively, an area for improvement in these divisions. Interesting and pleasing is that the executives also rating very high for this element at 91%.

5.2.3.5 Capable of taking part in or conducting a Workcover review

Respondents were asked if they were capable of being involved in a Workcover claims review. The overwhelming majority of respondents (91%) reported that they felt capable. VIP was significantly lower than all other divisions at 77%, this may be due to the fact that specific workcover resources have been added to all other divisions except VIP. The executives also rated high for this element.

5.2.3.6 Capable of taking part in or conducting a Safety Initiative

Respondents were asked if they were capable of organising a safety activity or initiative with the aim of improving plant OHS. Again the overwhelming majority of respondents (97%) reported that they felt capable. The results were consistently high across four of the divisions, with only three, Pulp & Paper, Food and Board not achieving 100% per cent, showing that all divisions feel they are capable of running safety initiatives to improve safety in their division. Even the executives had a 100% yes response, indicating they are more than capable to conduct a safety initiative.

5.2.4 Engagement in Safety Activities

As demands for quality and productivity increase, senior management require a broader skill base and the demonstrable willingness to engage in the varied (OHS) organisational responses to assist them in managing morale, risks as well as high performance. To this extent the results presented in Table 5.4 provides an initial assessment of management involvement in OHS critical functions.

	DIVISION								
In the last 6 months have you taken part in:	**Specialties (n=15)**	**Pulp & Paper (n=10)**	**VIP (n=17)**	**Recycling (n=26)**	**Vispak Beverages (n=15)**	**Vispak Food (n=9)**	**Visy Board (n=15)**	**Executives (n=11)**	**Full Org. (n=120)**
	%Yes	%Yes	%Yes	%Yes	%Yes	%Yes	%Yes	%Yes	%Yes
Safety committee meeting	80	90	94	88	87	89	93	55	85
Work team Meeting	87	100	94	96	100	67	100	91	93
Plant Risk Assessment	73	70	59	81	73	44	60	27	64
Chemical Risk Assessment	13	50	29	8	20	22	33	9	21
Safety Inspection	80	70	82	77	73	78	67	36	73
Training in OHS	40	60	65	42	87	44	67	45	56
Accident Investigation	47	50	35	62	53	56	53	27	48
Workcover Review	67	80	53	65	47	67	60	64	62
Safety Initiative	87	80	71	89	87	78	93	82	83

Table 5.4: Engagement in safety activities dissected by division – Climate Survey I

5.2.4.1 Taken part in a Safety Committee Meeting

Respondents were asked whether they had attended a safety committee meeting in the last six months. The overwhelming majority of respondents (85%) reported that they had. All divisions had a high positive response, all 87% or higher, with the exception of Specialties at 80%. This indicates that there is a good safety network of meetings taking place in the organisation. However, the executives rated poorly, with only 55% attending a safety meeting in the last six months, this is a recommendation for improvement, senior management should be involved in safety meetings.

5.2.4.2 Taken part in a Work Team Meeting

Respondents were asked if they had discussed safety at a work team meeting in the last six months. The overwhelming majority of respondents (93%) reported that they had. Visy Food had a very low positive response compared to all other divisions at 67% indicating that safety needs to be discussed more regularly at team meetings in this division. This result may also be due to a lack of understanding of the definition of what is a work team meeting, some divisions are using the term shift meeting or toolbox talk. Executives also had a high positive response in this element at 91% which is a good result.

5.2.4.3 Taken part in a Plant Risk Assessment

Respondents were asked if they had taken part in a plant and equipment risk assessment in the last six months. In this case only 64% of respondents said they had. There were mixed results in this response ranging from 44% in Visy Food to 81% in Recycling, indicating an inconsistency of expectation in this regard across the organisation, this forms part of the recommendations. The executive had a low positive response at 27%, however, often this activity is delegated to lower levels.

5.2.4.4 Taken part in a Chemical Risk Assessment

Respondents were asked if they had taken part in a chemical risk assessment in the last six months. As noted above, most respondents felt knowledgeable in this area and as such only 21% reported they had participated. Again the results vary greatly across the divisions as with the last element and a similar recommendation about consistency is required. However, there is also a need of awareness as many respondents did not believe they had to do risk assessments for all chemicals they use.

5.2.4.5 Taken part in a Safety Inspection

Respondents were asked if they had conducted a safety inspection in the last six months. In this case 73% of respondents said they had. The results across the divisions did vary from 67% in Visy Board to 82% in VIP, results were not high in general, with the executive response at 36%. These results are not surprising, improvement needs to be made across the organisation in this regard.

5.2.4.6 Taken part in training on OHS

Respondents were asked if they had attended training on some aspect of OHS in the last six months. In a further poor reflection on training commitment at Visy at the time only 56% reported they had taken training. Results were particularly poor in Specialties (40%), Recycling (42%) and Visypak Food (44%) and needed to improve, also low were Pulp and Paper (60%), Visy Board (67%) and VIP (65%). The exception was Visy Beverage with 87%, a good result and believed to be the consequence of a safety leadership program that has been driven and rolled out across the division in the last two years supported by the divisional executive. The executives had a poor result also with 45% indicating they have not taken part in safety training in the last six months.

5.2.4.7 Taken part in an Accident Investigation

Respondents were asked if they had conducted an accident investigation of any medical or lost time injury in the last six months. In this case only 48% of respondents said they had. The results across the divisions varied from 47% to 62%. This result was affected by some sites that did not have a significant injury requiring an investigation. However, there may have been near misses that could have been investigated, perhaps this question could be better worded to state 'any incidents investigated'. The executive also had a low positive response for this element at 27%, perhaps for the same reason but less likely as they cover a much broader area over several plants.

5.2.4.8 Taken part in a Workcover Review

Respondents were asked if they had been involved in a Workcover claims review in the last six months, in this case 62% of respondents said they had. Visypak Beverages was the lowest at 47%, the highest being Pulp and Paper at 80% positive response. This may be due to the fact that some divisions, like Beverages, have specific resources to address Workcover issues, however the communication still needs to be there, an area for improvement. The executives rating were higher at 64%, comparatively, perhaps due to involvement in more serious Workcover claims and that they cost a significant amount of money directly for the division.

5.2.4.9 Taken part in a Safety Initiative

Respondents were asked if they had organised a safety activity or initiative with the aim of improving plant OHS in the last six months. The majority of respondents (83%) reported that they had. The responses across the divisions was high, all 78% or higher, however, VIP was a

little lower at 71%, indicating more improvement is required in this regard in this division. The executives again were high at 82% which is a good result.

In summary, in the majority of instances, respondents perceived themselves to be capable, however, there is insufficient engagement in training and other safety related activities to support the development of specific OHS competencies. There was also a large variance between divisions, even more so than capabilities indicating a lack of consistency in the organisation, this forms part of the recommendations.

5.3 Qualitative Discussion

The qualitative instrument utilised for this research was developed using OHS Best Practice principles and adapted to investigate the specific OHS needs of Visy Industries. The instrument is included in Appendix 5.1. The aim of the discussion associated with the qualitative discussion is to report on the major issues identified in each division. To gain a more in-depth understanding of the results of the questionnaire surveys and to obtain recommendations for improvement in the organisation. The detailed analysis of the qualitative information is contained in Appendix 5.3, the analysis is sorted by each of the divisions, Recycling, Pulp and Paper, Visy Board, Specialties, Visypak Food, Visypak Beverages, VIP and the Executives. Within each division the analysis is sorted under the key themes identified below. The approach taken to analyse the responses is that suggested by Ryan and Bernard (2010) where text is studied and summarised to determine major themes which is broken down further into minor themes which form part of the results of analysis (see Figure 3.1).

The interviews were conducted by telephone to a script and recorded. These were then sent to be transcribed. The transcriptions were then corrected for spelling and wording errors and then printed out. The first analysis was to read all of the scripts and to highlight key comments, key words and feedback. The text was also placed into N-vivo, a word analysis package to also help to deduce major themes.

Based on this approach the following major themes were identified across the divisions with respect to OHS:

1. Existing System and Processes
2. Change Management
3. Training

4. Legislation

1. ***Existing System and Processes***

Many of the responses revolved around the existing systems and processes and thus was analysed further.

1a ***Control of work environment*** – the level of control individuals had on their work environment with respect to safety. Generally there was a belief that the individual had a high level of control of their work environment, particularly at management levels.

1b ***Injury Procedure*** – what were the existing processes and systems with respect to injuries and how were they managed? The results varied greatly across the divisions and even within divisions that were geographically diverse. Some sites had good, advanced systems and addressed the issue aggressively with extra resources and regular follow-up and review. However, some sites had no resources, systems or processes in place. The lack of consistency appears to be the greatest issue in this area.

1c ***Positive elements*** – what were the good points about the existing systems and processes? The positive elements, although varied greatly again across the divisions within Visy, consisted of:

- Good risk management processes
- Good priority for safety issues
- There had been some good training in some divisions such as Beverage and Recycling
- The networking and communication was a highlight in some areas
- Follow through on safety discipline was seen to be positive in two divisions
- There were a few comments made that the current new initiatives were promising.

1d ***Negative elements*** – what were the aspects of the existing systems that were working against safety improvement? Often the negative elements were the opposite to the positive elements but in different divisions or sites, these included:

- Concern that management is solely responsible for safety
- Focus on status quo rather than continuous improvement
- Current system is not formal and consistent
- Safety not seen as a top priority in some divisions

- The focus on individual responsibility and reliance on individuals
- The balance between safety and productivity was not correct in some areas.

1e ***Risk*** – the principle risks that workers were exposed to was a common discussion prompted by the questions. The main risks mentioned in most divisions included:

- Fork trucks and traffic management
- Chemical hazards and cleaning
- Machine guarding on older machinery
- Manual handling in some high volume handling activities
- Electrical safety and qualifications to perform electrical work
- Strains and sprains with respect to an aging workforce
- Noise levels in some high processing areas

2. ***Change Management***

After comments on the existing system, the questions brought out a lot of discussion on ways to move forward with respect to OHS.

2a ***Changes in roles and responsibilities*** – the constant change in some divisions was seen to be a challenge on managing safety going forward. It was quoted that often a person would be assigned safety duties or support functions and then the structure would change and those would be the first jobs to go.

2b ***Ways to improve*** – there was a lot of good feedback on ways to improve the existing systems and processes. Common responses included:

- Better communication of safety information
- More commitment by senior management.
- More training and understanding required at all levels in the organisation.
- Differences in safety standards, they need to be standardized.
- More continuous improvement associated with safety programs
- More capital projects focused on safety improvements, automation.

2c ***Making changes*** – there was also feedback on how changes should be made to learn from past mistakes and continuously improve. Particularly between divisions,

often one area of the organisation would not hear about a significant incident in another area.

2d ***Performance impact of a new strategy*** – one question was focused on the new strategy so the impact of this was discussed. It was generally felt the new strategy would be beneficial as long as it had strong commitment from the top of the organisation. Commitment in money and resources, also that the strategy was ongoing and sustained, not just another fad or project.

2e ***Changing culture and commitment to OHS*** – a major topic was the culture and commitment to OHS and how that could be improved. There were a few suggestions put forward including; additional funding, management leadership, measurable results, more cooperation and less blame when an incident occurs.

3. ***Training***

This was identified as a major discussion point by many respondents (type of training, how much etc.). Generally it was thought the training was insufficient and lacked consistency and quantity.

4. ***Legislation*** – Often the respondents mentioned legislation as the reasons for safety compliance and sometimes their lack of understanding of these requirements. There was a lack of true understanding of legal requirements and what they meant in practice. More training, support and guidance was needed in this area.

From this analysis (details contained in Appendix 5.3) and the quantitative analysis, conclusions were established and they became a set of recommendations to the company. These recommendations were also integrated into the knowledge approach developed in this study.

5.4 Climate Survey I Conclusions, Recommendations and Actions Taken

In conclusion, most respondents agreed with statements concerning safety climate. In reality this indicates that management and OHS professionals perceived Visy's safety climate to be mediocre at best in 2005. If these groups perceived only an average safety climate, the perception of employees will be far worse as they lead the safety initiative. A strong safety climate and high levels of safety performance are driven by strong commitment and leadership from management (all levels) and OHS professionals. Visy was found to be under performing in the management of occupational health and safety, and the perceptions of employees reflected the sentiment and perceptions of management expressed here. Additionally, there was a very poor perception of the level of OHS training at Visy generally, and this was again a reflection of the low levels of commitment to OHS strategy and performance in 2005.

The recommendations listed below are not dissected by division, as a decision was made to take the company forward as a whole. The results were presented to the senior management at the end of 2005. The action taken by Visy is given after each recommendation and was implemented in the months after the results were presented and passed by the company board. Interestingly, while there was a considerable amount of variance in answers between the divisions, there was also a significant amount of difference within the divisions as well. This difference highlighted the range of differences in OHS standards, implementation and understanding throughout Visy. Each of the recommendations listed below reflect comments made by respondents in 2005. Some of the recommendations actually reflect activities that already exist within various divisions.

5.4.1 Recommendation 1: Resources

Visy must engage in specific strategies, which will most definitely require the investment of significant resources, to ensure the basic level of OHS compliance of all plants is comparable. From the data it was very clear that some plants are performing far better than others, and some divisions were doing better than others. The main factor preventing such basic, foundation level standards being met was not a lack of commitment necessarily from employees, but a lack of resources. There was a range of resources needed: time, money and importantly dedicated expertise to drive the improvement process.

Action taken for recommendation 1

Specific resources were added to the organisation, firstly, a complete safety structure was put in place with a full-time safety professional for each division, as well as defined roles and responsibilities at every plant and location. There was also a special process put in place for capital on OHS initiatives to accelerate and support this process and signed-off by the safety professionals.

5.4.2 Recommendation 2: Training

As part of the improvement process outlined in Recommendation 1, there is a critical need for a training competencies template. This template should outline the training courses that need to be completed, the people that need to complete them, the capabilities that will be gained and the time frame in which they need to be completed. This is a key method for up-skilling the workforce and providing them with the skills to reach the objectives of recommendation 1.

In order for this recommendation to be successful, managers must be provided with support and guidance to cope with the financial and time-based needs of such training.

Action taken for recommendation 2

A training matrix was put in place in most divisions. Where there was not a training matrix, there was a roles and responsibilities statement added to performance reviews including a specific safety element. Also, certificate IV training was offered for all people with safety responsibilities. This increased the number of qualified safety people within Visy from 6 to 64.

5.4.3 Recommendation 3: OHS Expertise

There must be more dedicated OHS experts for each division. Managers and OHS professionals are fulfilling multiple roles and hence are not able to keep up with the amount of information they need to understand, particularly in terms of legislation. People find the legislation complex and too dynamic to follow. If they do not understand the full extent of the legislation, they cannot action it. The most appropriate person to engage in such an activity is an OHS expert.

Action Taken for recommendation 3

As part of the new safety structure, there was a dedicated safety professional added to each division and in divisions such as Pulp and Paper and Visypak Food extra safety professionals were added at the plant level. These staff needed to have tertiary qualifications in safety as part of the selection criteria for the positions.

5.4.4 Recommendation 4: OHS Communication

In order for recommendation 3 to work, a communication strategy needs to be designed and implemented. This strategy, along with the an increased awareness of OHS issues increased, required the identification of one contact person at each plant whose responsibility it is to disseminate information. This information can be presented by this person during meetings or through other forms of written communication. This process assists in spreading the responsibility and engages a broader spectrum of people.

Action taken for recommendation 4

As noted in recommendation 1 above, with the safety structure in place, there were roles and responsibilities defined including communication requirements. Also, network meetings were conducted every quarter in every jurisdiction including New Zealand to help communicate safety requirements and initiatives taking place throughout Visy. OHS meetings became a requirement at every plant with over fifteen employees, which had to be documented and reported in the safety scorecard.

5.4.5 Recommendation 5: OHS Performance

The gauging of OHS performance at Visy needed to be assessed by more than lost time injury records and Workcover claims. These are extremely negatively oriented measures that are de-motivating for employees. Visy needed to develop positive performance measures that drive OHS actions and improvement.

Action taken for recommendation 5

The safety scorecard with the 14 measures mentioned in chapter 3, section 3.3.8 was adopted. This data includes a range of leading and lagging indicators and is reported from every location every month and negative variances acted upon as well as positive targets set each year. The responsibility of the scorecard performance was directed at the management of the site, not the safety professionals.

5.4.6 Recommendation 6: Knowledge sharing

There must be more forums, such as an OHS conference, that enabled for OHS professionals to share their knowledge, exchange good ideas and network.

Action taken for recommendation 6

An annual safety conference was set up each year in alternative states which included all safety people from around Australia and New Zealand, the senior executives as well as all relevant managers from that state would attend, often over 120 employees. The senior executives had to

present at the conference on safety progress and initiatives in their division to the recommendations listed.

5.4.7 Recommendation 7: Commitment

The final critical recommendation is to encourage commitment and culture change through action. People within the organisation were interested and motivated by the changes that were occurring. The momentum needed to continue and to do so corporate needed to show commitment through taking significant tangible steps toward making change. This required significant resource investment; however, employees recognised this and their performance levels would improve to reflect the investment.

Action taken for recommendation 7

Through roles and responsibilities, commitment and change was implemented in the organisation which included a significant investment in resources and OHS activities noted in other recommendations.

As a summary, Visy had to adopt the following principles in these recommendations, which mirror the principles of sound safety management:

- Goal: Zero accidents
- Focus on the employee (end user)
- Incident analysis
- Written policies, procedures, guidelines and expectations for safe behaviour.
- Safety committees
- Employee participation, involvement and commitment i.e. power to point out unsafe behaviours, stop production if it is unsafe.
- Focus on proactively incorporating statistical analysis of past events
- Focus on safety culture and organisational change, continuous improvement and organisational learning
- Assumption that all accidents are preventable

Through the actions taken significant resources, time and effort was put in place, this formed the safety strategy presented in section 6.3.3. These were incorporated through the practical applications described in the next chapter.

5.5 Summary of Chapter 5

This chapter presented the first climate survey results and set the benchmark for the rest of the study for which improvements and the research question could be tested. The study used both qualitative and quantitative data to gather both facts and explore ideas and concepts for going forward. The qualitative data showed that Visy was not in a good position with respect to safety in 2005 and there was a lot of room for improvement. There were mixed results: a lack of consistency, structure, systems and approaches throughout the organisation. There were several key recommendations made to the company and these were subsequently acted upon. This allowed a comprehensive strategy to be implemented in the form of practical applications described in the next chapter.

CHAPTER 6

PRACTICAL APPLICATIONS

6.1 Introduction

This chapter introduces the sixteen practical applications applied in this study to address the research question: does the application of knowledge management principles to safety improve safety performance? Section 6.2 introduces each of the applications with a brief description. Section 6.3 contains a background of each of the applications and how they were applied in practice. Section 6.4 is a detailed analysis of how the practical applications related to knowledge management and the concepts used to achieve this. Section 6.5 describes the method of knowledge transfer for each of the applications. Section 6.6 then describes how all the applications were implemented in practice. Within the organisation, these were integrated into a safety strategy which was implemented over the period from 2005 to 2008. The initiatives that were implemented are summarized in Table 6.2 and described at the end of each practical application as "Action taken". More background is presented in the appendices (6.1-6.15). The feedback on the success of the applications was given in the second climate survey in chapter 7. The results and improvement of safety knowledge that was achieved and measured in these initiatives is discussed in more detail in chapter 8

6.2 Development of the practical applications

This phase of the study involved 16 applications as listed below and described in some detail in subsequent sections of this chapter.

1. Legislation and Regulations – the basis of the modern safety environment is the relevant occupational health and safety legislation and the relevant laws.
2. Safety Leadership and Culture – senior management commitment and policy is needed to implement a good safety culture.
3. Safety Strategy and Action Plans – the approach by which management can implement a good safety culture.

4. Risk Management – the basis for modern legislation and a means to justify safety actions and prioritise them.

5. Safety Systems – To imbed the risk management approach and associated controls, a safety system should be used which can be basic or complex depending on the level of risk.

6. Employee Consultation – the process by which ownership, development and implementation of a safety system is achieved.

7. Behaviour Based Safety – a more formal approach to creating a positive safety culture and approach.

8. Work Environment – the monitoring and improvements carried out in the physical workplace.

9. Injury Notification – the process by which injuries are notified and recorded.

10. Incident/Accident Investigation – the methods and processes by which incident are investigated to prevent them from happening again.

11. Safety Training – the process by which safety knowledge is disseminated within the workforce.

12. Auditing and Compliance – the method which ensures the ongoing improvement and implementation of the safety management system and performance measures.

13. Measurement and Statistics – the actual performance indicators used to monitor the safety performance, both leading and lagging indicators.

14. Injury Management – the process and procedures used to manage a person after an injury has occurred.

15. Health and Wellbeing – the methods used to look after the overall health of the workforce not just their safety or when they are injured.

16. Off-the-job Health and Safety – promotion and activities to help people prevent injuries even when they are not at work.

6.3 Practical applications

This section presents the background and the actions taken relating to each of the 16 applications.

6.3.1 Application 1: Legislation and Regulations

Background

Safety legislation is a very complex area in Australia and prescriptive as described in section 2.2.3.1. However, despite all this prescription in Australia nationally, there are still a significant amounts of injuries every year costing billions of dollars. The International Labour Organisation (ILO) ranks 25 established market economies for their OHS performance. Using non-standardised ILO data, Australia is ranked seventh behind the UK, Sweden, Switzerland, Finland, Norway and Denmark. Even with some adjustment for comparative purposes, Sweden, the best performing country, is still three times better than Australia in relation to traumatic events (Stewart-Crompton, 2003).

Based on all this legislation, the safety in the workplace has not improved as significantly as expected (Ellis, 2004). This researcher argues that improvements are the result of actions that take place in the workplace. The legislation does not cause someone to go and pick up a pair of safety gloves; it is the interpretation of the legislation that leads to action.

Very few people can recall or quote the legislation, it exists in the background (Berger, 2006). Indeed, best performing safety companies perform well beyond the legislation. Meeting legal requirements is a minimum standard. The legislation on its own is simply information and threat of prosecution. In order for it to be useful it needs to be turned into action. The action taken in the sub-sections under each of the practical applications provides many examples of how this action is created.

There has been a move away from prescriptive legislation to a ‘Robens’ style’ (HMSO, 1972), performance-based legislation. This provides broader guidelines and responsibilities instead of prescription, such as responsibility for assessing the risks and controlling them. However, in order for this type of legislation to be implemented in the workplace, it needs to be interpreted, such as assess the risk of falling from height and implement a fall protection device or other type of control. Prescriptive Legislation did not work in all situations and would sometimes

increase the risk. An example of this is a prescription that access to a roof should be kept at all times in case of an emergency. A new ladder was fixed to the roof, to allow access. An employee then climbs the ladder, slips and falls and injures themself. In fact a permanent access is not required but when access is needed a lifting device is hired preventing the risk of falling from a ladder. Hence, prescriptive legislation may not always work, however guidelines are still needed to help employers improve the way they are implementing safety improvements.

Another significant issue with legal compliance is the level of interpretation. It becomes very difficult for an employer to know where to start with respect to meeting their legal compliance. It can also appear to be too overwhelming and too difficult to know where to start. That is, if the employer knows what their legal responsibility is in the first place and even less is known about how to implement it.

There is also the issue of the variation in legislation. There is considerable variance between different legal jurisdictions in Australia. In recognition of this and in order to address the issue, there have been moves to the national reforms of the Committee of Australian Governments(COAG) (Sherriff, 2010) which aims to introduce one OHS Act across Australia. But that is still a quite a long way off being uniform and varies greatly by the enforcement in each state and does not always fundamentality improve the safety at the workplace.

Considerable emphasis needs to be placed on first training employers on what the acts mean and their intent followed by providing more practical advice and application in practice. This has particularly been addressed in the state of Victoria (Australia) with conservable benefits delivered as it is the best performing state in the country with the cheapest Workers Compensation rates as shown in the latest report by Safe Work Australia (2009).

Action taken for Legislation and Regulation

As discussed, OHS legislation can be very complex, hence, the most important part of implementing a knowledge-based approach to legal requirements is to create simple understanding of the legislation. Even more important is to identify what management and workers need to do in practice to meet the requirement. The following actions were carried out to transfer this knowledge into the workplace:

A Safety Law Registry – subscription to a web-site which provides details of the latest legal changes in simple language. This can be accessed by safety contacts and managers in the business.

B Executive training – specific training on legal requirements for senior management so they understand the requirements and what they must do in practice. This consisted of several sessions conducted around the country of approximately two hours duration each, given by a lawyer and an experienced safety professional.

C Quarterly updates – each quarter, updates were presented around the business to management and safety contacts on safety requirements which included any legal changes that have occurred that may affect their business operations and needed to be adopted by the site they are responsible for.

D Risk Assessments – formal reviews were carried out of equipment and purchases before the items were approved by finance. This forced management to use safety professionals and contacts to assess equipment legally before it was purchased.

The outcomes and improvements from these actions and others presented in this chapter are discussed in Chapter 7, the second climate survey results and Chapter 8 where the results are discussed.

6.3.2 Application 2: Safety Leadership and Culture

Background

The basis of any safety improvement is strong leadership from senior executives in an organisation. Safety is often a change management program that requires strong leadership. But how does one engender a strong safety ethic and leadership in a world that is driven by profits and quick returns on investment? And how do you convince a senior executive to invest in a safety program that requires a large amount of money and resources? This researcher recommends that to create safety leadership three areas need to be considered: Costs, Legal responsibility and Moral obligations. Safety leadership was defined earlier based on the work of Weinstein (1997), Hofmann, (1995), Roughton and Mercurio (2002), Hansen (1993) and Erickson (1996), see chapter 2.2.3.2. In summary safety leadership is about senior management showing commitment and passion towards safety, not just considering it as

something they have to do in a senior position. In summary, commitment can be shown in a number of ways:

- Participation in safety activities, such as workplace audits or risk assessments.
- Attending or even chairing safety meetings.
- Providing resources and support for safety programs and training.
- Mentioning safety issues and items in other meetings.
- Participating in and providing safety awards.
- Asking about safety requirements with respect to capital and major projects.
- Including safety in performance assessments of direct reports.

Another way to create commitment would be through prioritisation. For example, raising capital for a new machine verses fixing the guarding on an old machine. Fixing guarding on an old machine first would show commitment. It may cause conflict that may appear between what has a higher priority safety or production. When the manager shuts down a machine for the safety of staff they then demonstrate their commitment towards safety as a higher priority than production.

One needs to distinguish between safety leadership and safety management. Safety management is about the processes, systems and practices in place for safety and how they are managed. Safety leadership is more about commitment and passion as stated. Another important aspect of safety leadership is to create the commitment and passion in others towards safety. Senior management, as stated earlier, can be influenced in three ways; costs, legal responsibility and moral considerations. These are elaborated upon below:

1. **Costs**

   By far the biggest driver for business is profit. If profits improve, there is more money to grow and invest in the company. However, safety is hard to link directly to profits, it is not like sales where there is a more direct link. Safety is often seen as an insurance or minimum legal compliance requirement, rather than a profitable initiative. It is seen as a necessary cost, although a good safety system and program with strong leadership can significantly improve profits. This is done by considering all the costs associated with injuries and poor safety. For costs associated with injuries, the ‘accident iceberg’ provides a good indication of the total costs associated with injuries. However, there are also direct costs associated with injuries that come straight off the bottom-line profit. The workers’

compensation costs are directly taken out of profit. These costs are the best place to start when gaining an understanding of safety costs to help gain commitment from senior management. Also, these costs are often associated with three years of injuries or rather, claims, hence they are well under the true costs associated with the injury. Studies have shown that the total cost of injury being 4-7 times the workers' compensation cost (Rikhardson & Impyard, 2004).

Hence, the best way to first convince senior management about engendering safety leadership and appropriate commitment is through identifying the total costs of safety in the organisation. Once this significant cost is calculated, it can then be used to highlight how safety can greatly reduce these direct and indirect costs. For example, improved injury management of claims by the early intervention in treatment of workers can greatly reduce the workers compensation costs as shown in this research study.

2. Legal Responsibility

There are significant legal responsibilities on senior management to provide a workplace that is safe as far as is practicable. There are significant fines and personal liabilities across all states and territories in Australia. For example, the Occupational Health and Safety Act (2004) Victoria includes specific offences for senior officers. Sections 144 and 145 of the Act establish that a senior officer can be found guilty of an offence if there has been a failure to take reasonable care. The Work Health and Safety Act (2011) in NSW and other states is the new harmonised Act. The associated regulation in this respect is that people in-charge of a business or undertaking would not be able to rely solely on executives' and managers' assurances of OHS compliance, but would need to satisfy themselves of corporate and individual compliance via informal reviews and audits of OHS management systems.

Hence, the law in terms of Acts and Regulations can help to convince senior management of the requirements for safety leadership and commitment. This represents legal requirements in terms of senior management's personal liability and exposure. There is still the aspect of company cost and exposure under the Acts and Regulations. Significant costs and fines can result from non-compliance, if found guilty of an offence under the Act. Considering many senior management have an ownership or investment in the company, there can be a financial exposure indirectly here. The costs associated with fines

from prosecutions are increasing continuously. Over the last three decades, each OHS Act has increased with each review, the fines have increased from $50,000 in 1985 to $250,000 in 1997 to $840,000 in 2004 for each offence (Sherriff, 2010). Again these represent only the direct costs or fines, there can be significantly larger indirect costs in terms of time and resources to deal with or defend a prosecution.

3. Moral considerations

All the issues considered up until now have been largely financial and legally based. However, there is a strong community value around a safe workplace, everyone expects to go to work and come home safely and without injury. As the Victorian Worksafe campaign promotes, "The most important reason for workplace safety is not at work at all"(highlighting the need to return home safely) (Worksafe, 2007).

Hence, there is a strong moral and ethical obligation on senior management to show safety leadership in the workplace. By far the biggest impact is on the emotional state and well-being of those involved in a serious incident. For example, a worker that was associated with a forklift fatality at work could not return to the workplace and could not drive any vehicle for many years after the event. A few of the immediate co-workers also left because of the emotional trauma of losing a colleague at a workplace before the incident occurred.

Sometimes it is hard to convince senior management of this requirement unless they have experienced it themselves, they can only imagine what it would be like and sympathize. Many are still of the belief that a tragedy would not happen to them or in their workplace. But accidents do happen and often a failure of safety leadership can be found to be a cause of the incident, or rather effective leadership decisions could have prevented the incident through appropriate action in the workplace.

Action taken for safety leadership and culture

It is fundamental and greatly emphasized by many practitioners that good safety performance is based on good safety leadership and a good safety culture. In practice it means the transfer of safety knowledge to senior management through the following methods which were implanted in the organisation:

A Involvement in safety activities - having senior management specifically take part in safety activities such as workplace inspections, risk assessments and OHS

meetings helped to engender a safety leadership in the organisation as shown by the second climate survey improvements discussed in chapter 7.

B Linking safety performance to individual performance measures and targets for management bonuses - A process by which safety activities are measured and then linked to management incentives. For example, the number of workplace audits completed each month by site and division are measured and included in annual performance reviews.

C Safety Leadership Team – A specific senior management "safety committee" that drives the safety system and actions to be completed back through their respective areas. The team reports and monitors on their respective areas the progress towards action plans and performance with respect to safety measures and requirements.

D Senior management on safety committees – Not only did senior management become a part of the safety leadership team for the organisation, they were also part of the divisional committees as well to transfer the safety information and knowledge up and down the organisation and to be fully aware of the specific issues in their respective area.

E Conferences on OHS – A specific conference on OHS was conducted annually where each senior manager had to present on progress within their respective divisions including safety performance, progress to action plans, learning and key activities.

6.3.3 Application 3: Safety Strategy and Action Plans

Background

Safety strategy can mean many things to many different people, particularly in a large organisation. The safety strategy is the basis for which Visy identified key initiatives for improvement to its safety program. A safety strategy can also be a safety plan, simply the strategy is the overall "helicopter view", whereas the safety plan has a lot more detail, both should exist.

A strategy needs considerable input and involvement right from its inception. It needs a driver or facilitator to help it to come together, who must have appropriate standing across the organisation and rapport to the highest levels of the organisation. The two most important

aspects to consider when developing a safety strategy is the level of safety knowledge at different levels of the organisation and the level of accountability at different levels of the organisation.

Once the necessary data has been gathered and analysed, a strategy can start to be developed. This could take up to 12 months but 3-6 months should be sufficient. A safety strategy should be designed for the most senior leaders in the organisation.

The overall safety strategy used in this study, presented in Figure 6.1 below, shows this, it is based on the Dupont Cultural Development model (Wokutch, 2000). It consists of Strategic safety components which are fed into the safety plan or "journey" in the middle to move toward the safety vision on the right. The adapted model consists of 5C's which stands for; Crisis, Control, Compliance, Commitment and Culture. In brief, first the company is in Crisis and responding to external pressures to improve safety, such as improvement and PIN (Provisional Improvement Notice) notices by the regulator. Then progress is made to Control where there are some basic policies and procedures in place but those are still driven by management. Then training is put in place to get more ownership at least to the supervisor level but is still a Compliance driven approach where employees require a type of 'policeman', such as being constantly reminded to wear PPE (Personal Protective Equipment). Commitment, where all employees fully understand the reason for the safety steps they take in their everyday jobs and do not need to be reminded or supervised to achieve compliance. Finally, Culture where employees not only follow the requirements but come up with improvements themselves to continuously drive safety improvement. This journey continues over many years depending on resources available and leadership and the overall change process.

The three curves on the chart of Safety, Workcover and Health and Wellbeing in Figure 6.1 are shown in terms of cost. First, the cost of Workcover is very high but decreasing as safety improves through the journey. Then, the safety curve shows an increase initially to drive and develop safety systems but as they get implemented and standardized and driven to supervisors and employees from management, the safety costs decrease. Finally, the Health and Wellbeing costs increase steadily to a constant state as the costs of carrying out programs and training increase until they are a part of the regular operations. The solid black curve representing the total costs to the company gradually decreasing over time, showing the benefit financially in safety improvement.

The safety plan prescribed in Figure 6.2 provides more detail of specific programs and initiatives under each of the core strategic safety components, this is where the practical applications are applied into the organisation. Once the strategy and the initial plan are developed and tailored to the organisation, then a presentation can be made to senior management for buy-in to supporting the aspects of the strategy and plan for resources and costs.

Action taken for safety strategy and action plan

The Safety strategy and action plan pulls together several components described here under the broad safety standards that were developed are presented in figures 6.1 and 6.2 below. The strategy determines the path to the safety vision in a time line through the specific safety plan. Each division then developed a specific action plan based on the safety plan which was updated quarterly and presented and reported to senior management.

Strategic Safety Components

1. Safety Strategy
Targets, Objectives, Plans

2. Safety Performance
Reporting of all injuries and measures

3. Safety Leadership
Supervision, management involvement

4. Safety Management Systems
Consistent, simple, MESH, Minimum Stds

5. Safety Training
Risk assessment, procedures, competent

6. Safety Community
Cross communication, sharing

7. Safe Environment
Physical environment, workplace, hygiene

8. Safe Contractors
JSEAs, induction, permits, supervision

9. Safe Behaviours
Observation, feedback, Stop and Think

10. Injury Management
Local ownership, consistent, skills

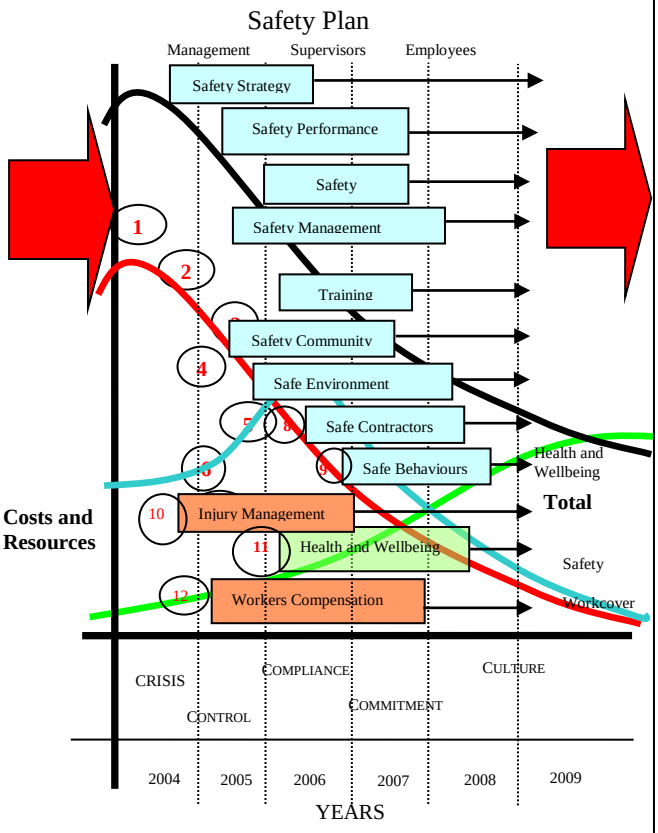
11. Health and Wellbeing
Awareness, understanding, impacts

12. Workers Compensation
Drivers, premium, claims costs, knowledge

Safety Strategy

VISION OF THE FUTURE

Continuous Improvement Safety Culture through engagement of all people who contact Visy,
Employees, Contractors, Visitors, Customers, Suppliers



Safety Vision

1. Safety Strategy
Safety standards across all locations

2. Safety Scorecard
Zero significant injuries (LTI + MTI(major))

3. Safety Leadership
Every Manager involved in a safety activity each month

4. Safety Management Systems
Every site at certification standard

5. Safety Training
5000 safety people, every employee involved in a proactive activity each year

6. Safety Community
Safety improvements from all levels

7. Safe Environment
All machines compliant to Australian Standards and 5S workplaces

8. Safe Contractors
Documented evidence of 4 standards for every contractor

9. Safe Behaviour
One observation per employee per month

10. Injury Management
No workers off work full time for an injury

11. Health and Wellbeing
No "at risk" employees, support holistically

12. Workers Compensation
Premium half the industry rate at every site

Figure 6.1: Safety Strategy implemented at Visy

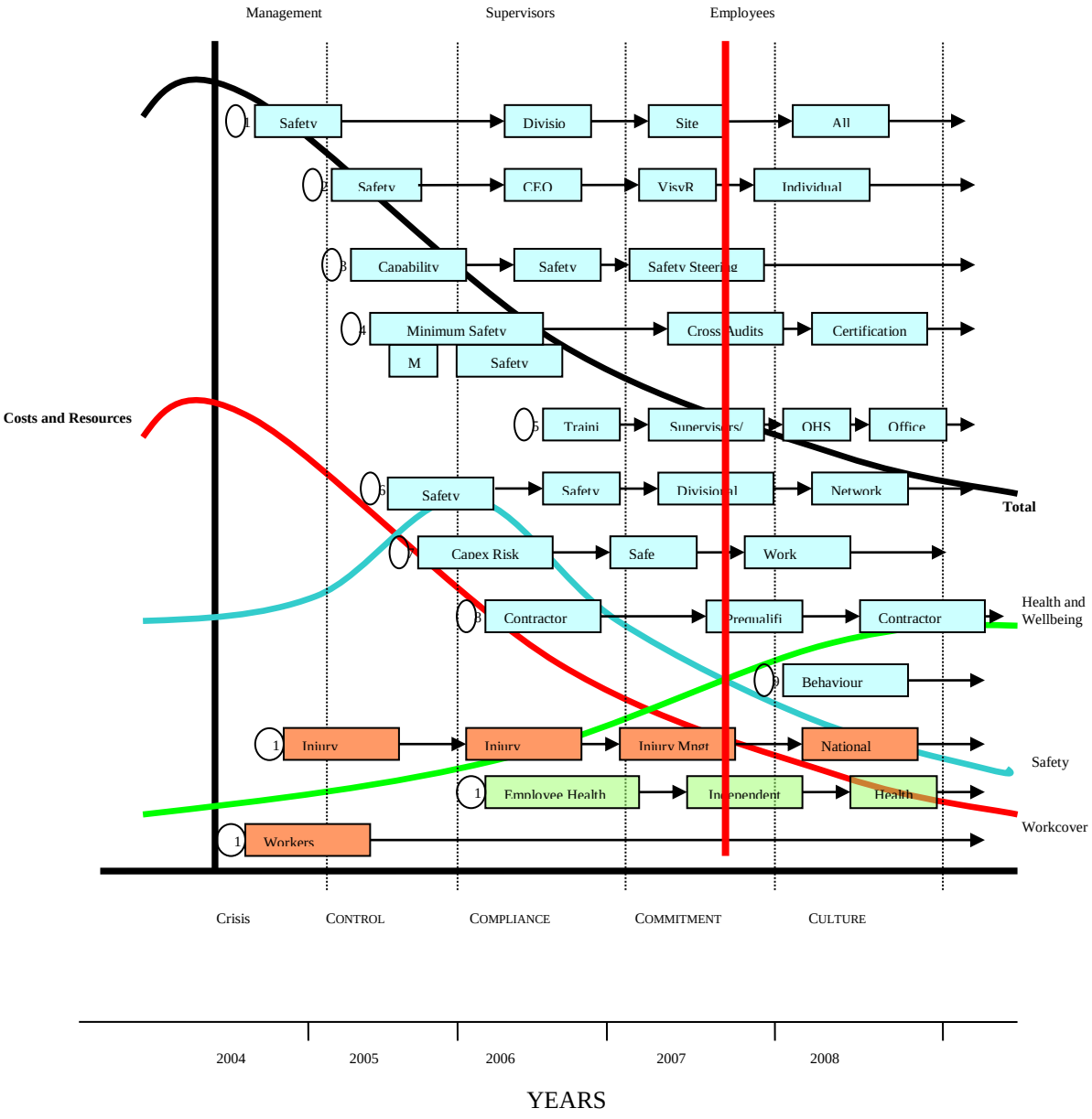


Figure 6.2: Safety Plan implemented at Visy

6.3.4 Application 4: Risk Analysis and Hierarchy

Background

The whole basis of legislation has moved from a prescriptive to a non-prescriptive approach. The onus of safety has been moved more from government and regulating bodies to employers. Hence, an employer can no longer demonstrate they have followed the guidelines and then an accident still happened, they are not to blame in any way. This transfer of the onus of safety has been achieved through a risk management approach. In other words, the prescriptive requirements have been replaced with a risk management philosophy.

However, prescription still applies in areas where risk management alone may not work. As an example, consider a high risk environment such as a confined space. A confined space is a space which creates an oxygen depleted atmosphere either by lack of ventilated space or by contamination of an atmosphere. If a person is in such an area for too long, they may suffocate and die. Using a traditional risk management approach of consequence, exposure and probability; the consequence would be high due to possible death. The possibility, due to exposure, would often be very low, the task may be done once a year or less, and the probability of the task resulting in death in the past is also low. Hence, the risk rating would come out as a low one requiring no action. Hence in this case a prescriptive regulation still needs to apply.

To fully understand what a risk is, first a hazard needs to be identified. A hazard is a potential to cause injury or harm. When we analyse the hazard for the chance of it resulting in an injury or harm, it then becomes a risk. The risk is then classified as high, medium or low. Based on this rating, a priority of action is determined. High risks are determined to be an unacceptable level of risk, the chance of an injury is too high and hence additional controls need to be put in place to reduce the risk to a more acceptable level immediately before work can continue. A medium risk is one that may not result in stopping the work but means additional controls should be developed and implemented in the short-and/or medium-term. A low risk is one that requires no further action as the risk is at an acceptable level as part of normal working life.

There needs to be a balance between simplicity and complexity in the analysis of risks. Based on the implementation of these aspects in practice and the experience of this researcher, the following criteria should be used to determine which risk approach to be used:

1. The risk approach will need to allow for legal requirements.
2. The risk assessment needs to be simple enough to be taught at all levels in the organisation (technology can help here).
3. The risk assessment should be commensurate with the complexity of the process or plant being analysed.
4. The risk assessment should consider a wide range of questions and issues.
5. It should develop a priority for action.
6. It should allow for a level at which the process should stop as it is inherently too risky to continue to perform the task or activity.
7. It should allow for higher escalation based on consequence.
8. It should allow for consultation with a range of people involved in the work.
9. It should allow for an assessment of the residual risk after control measures are put in place.
10. It should take into account other information that can be used to improve the validity of the risk assessment.
11. It should be flexible enough to allow for a range of situations and applications.
12. It should be able to be completed in a reasonable amount of time.

To achieve all of these criteria a multiple level of risk analysis approach is recommended by this researcher. A suggested approach uses the following risk methods (Adapted from Weinstein, 1997):

1. Stop and Think
2. Job Safety and Environment Analysis (JSEA)
3. Plant/Process Risk Assessment
4. Expert risk assessments

1. Stop and Think

This is a simple approach for one off, rare activities. It is similar to the thought that one has before taking risks that are perceived as acceptable in everyday life, such as crossing the road. However, it is a little more involved, it is a 'one page' of a few points of the risks and actions taken to mitigate the risks. It is suitable for tasks that are a one off and may not occur again and action needs to be taken quickly. For example, the unloading of a load from a truck that has moved during the journey and appears to be unstable. A 'stop and think' would state the

task and who was assessing it. The suggested actions may be to clear people from the area, stay in a forklift, remove the load from the top with the forklift. A simple poster and introduction program can be used for this approach, a Stop and Think poster which was developed for this method is presented in Appendix 6.1.

2. Job Safety and Environment Analysis (JSEA)

For tasks that are carried out more regularly and are rather simple, a job safety and environment analysis would be recommended, it is a more detailed analysis looking at the tasks and hazards that exist at each step of a job and evaluating how these can be mitigated or reduced to an acceptable level (see Appendix 6.2). However, this approach would not be adequate to consider all the risks in a piece of plant and equipment. For this, a more complex plant/process risk assessment is needed.

3. Plant/Process Risk Assessment

This involves a more detailed series of questions and analysis looking at all the different types of hazards associated with a piece of plant or equipment. To do this, a hazard checklist, such as that developed by Worksafe Victoria can be used. This is then extended to include a risk assessment (See risk assessment form in Appendix 6.3). For each of the hazards identified, a risk assessment involving consequences, exposure and probability is recommended. First, consequences are understood as the outcomes if the hazard caused damage or harm. This should relate to consequence that can be identified with such categories as First Aid, Medical Treatment, Lost Time Injury or Fatality. Also, a non-linear relationship should be introduced. Second, is exposure which covers how often workers are exposed to the hazard. Again, it needs to be related to quantifiable measures, for example, hourly, daily, weekly, monthly etc. Finally, there is the probability of the consequences occurring given the exposure. Again, this needs to allow for meaningful simple interpretation. These three factors are given a rating from 1-10 and then multiplied to give a risk rating for the hazard which can then be classified as High, Medium or Low for priority of action.

4. Expert Risk Assessments

In some cases the previous approach is still insufficient, such as a more complex piece of plant of equipment. For this, a Hazop (Hazard and Operability Study) or FMEA (Failure Mode and

Effects Analysis) can be used. These approaches examine each stage or event of the process for failures and controls put in place to mitigate failures. One needs' to ensure that the detail and level of analysis is dependent on the severity of the risk or consequences of a failure. This was identified in the Royal commission of the Longford disaster (Hopkins, 2002) which recommended that a more complex analysis and approach be carried out by area experts.

Hierarchy of Controls

For any risk assessment, once carried out, the controls need to be established and implemented. To do this, the hierarchy of controls is applied as defined in chapter 2, section 2.2.3.4. Often a combination of controls are required ranging from administrative to engineering. Action arising should be placed into action plans or online tracking systems to ensure follow through to completion, this is where computer safety systems can be used.

Action taken for risk analysis and hierarchy

As noted several times, risk management is the basis of most of the OHS legislation in most jurisdictions in Australia and overseas. The above four methods of risk management were introduced into Visy depending on the situation. To drive the risk program, a number of actions were implemented to transfer the knowledge within the organisation:

A Training – a comprehensive training program was run across all divisions. This involved several sessions of about four hours duration each to teach people how to conduct the different risk assessments and when to use which one and for which purpose.

B Database – a risk assessment database was established to contain the completed risk assessments and track the actions and controls developed from them.

C A positive performance indicator – a measurement was put in place for the number and types of assessments to be completed by each site. This was linked to the KPI's, as noted earlier.

D Targets and Accountability – once measured and consistent after the first 12 months, targets and accountability for completion were put in place across the organisation and were followed up by senior management.

E Purchasing, Commissioning and Operation – a risk assessment requirement was put in place for the purchasing, commissioning and operation of all new equipment to drive the measure and improvement going forward even further.

The results demonstrated in chapter 7 and 8 were significant in this area and contributed to substantial improvement in safety performance.

6.3.5 Application 5: Safety Systems

Background

The many Acts, Regulations, Codes of Practice and Standards in Australia amount to over 100,000. This researcher argues that the legislation needs to focus on the 'shop-floor' and the direct work environment, not on detailed Acts and Regulations. The Victorian Occupational Health and Safety Act is 287 pages and is hard to understand, a lot of training is required to fully understand it. It must be recognised that only knowledge, not information leads to action and many companies are looking for better ways, tools and techniques (knowledge) to transfer these requirements into the workplace. Safety systems can be used in this respect.

For a small workplace in a large or small company it is very difficult to convert this into practice to help prevent injuries and make the workplace safer. This researcher argues this would be physically impossible (See survey results from climate survey I in chapter 5). Since this cannot be achieved or is very difficult to achieve indicates that what is needed is a way to meet the intent of the regulations and legislation as applied in a "practical sense".

Many companies have developed manuals and procedures to meet the legislative requirements. However, even these can become very detailed and require extensive training to understand. To simplify this further, a policy needs to be developed to describe the overall company intent which respect to safety. But often a great divide exists between many manuals and procedures and the policy. The manuals and procedures are written by those who fully understand the requirements, such as the safety professional in the company and the policy is written for senior management to sign off to show they are committed. Emphasis needs to be placed on the people who need to be influenced the most, the employees on the shop floor and their direct management. This is often not the case and this point is also supported by Berger (2005).

Hence, a suggested best practice approach is to use a set of minimum standards specifying the basic requirements of the intent of the legislation. This can be covered in a couple of pages. When put in practice in an organisation, one manager described it as "the most useful piece of

safety information he has seen in 10 years." These were developed from the Australian Standard for Safety Management Systems, namely AS 4801. It has the following elements:

1. *General Requirements*
2. *OHS Policy*
3. *Planning*
4. *Planning, identification of hazards, hazard/risk assessment and control*
    i. *Legal and other requirements*
    ii. *Objectives and Targets*
    iii. *OHS Management plans*
5. *Implementation*
    iv. *Structure and responsibility*
    v. *Training and competency*
    vi. *Consultation, communication and reporting*
    vii. *Documentation*
    viii. *Document and data control*
    ix. *Hazard identification, hazard/risk assessment and control of hazards/risks*
    x. *Emergency preparedness and response*
6. *Measurement and evaluation*
    xi. *Monitoring and measurement*
    xii. *Incident investigation, corrective and preventive action*
    xiii. *Records and record management*
    xiv. *OHSMS Audit*
7. *Management Review*

However, AS 4801 has a shortfall. It is still rather subjective and requires an extension to include the specific requirements to be delivered. Although this would not meet legal compliance in 100% of cases, which would probably be unrealistic based on the earlier arguments. Hence, what is required is a set of elements that would meet the broad intent and cover a large percentage of the legal requirements as a manageable level of risk for the wide range of sites and organisations. For this study, a group of elements was chosen based on the AS 4801 standard, with an additional element of rehabilitation and return to work which is not covered by many of the safety systems and standards, however is an effective part of a full safety management system (See chapter 4, section 4.2).

Action taken for safety systems

To define specifics for each element based on the AS4801 standard that a site can follow in black and white needs to be defined and identified. Hence, each of the elements listed below in Table 6.3 includes some basic criteria as demonstrated in the minimum safety standards.

Element (adapted from AS 4801)	**Minimum Safety Standards**
1. Policy	• Safety on the agenda of every operational meeting
2. Aspects/Hazard Identification	• OH&S policy displayed and communicated
3. Aspect/Hazard Control	• Risk Assessment process documented. • Register of Risk Assessments created
4. Legal and other requirements	• Plant and Equipment evaluated and control plans established. • Periodic review of High, Medium and Low risks
5. Objectives and Targets	• Register of injuries kept • Register of all plant license requirements.
6. Resources, Roles, Responsibilities and Authorities	• Safety Management Plan for each site • Traffic Management Plan for each site
7. Competency and Training	• Training for each of the following: ➢ Executive Manager ➢ Plant Manager, Frontline Managers and Supervisors ➢ Safety Professional
8. Documentation	• Companywide, site and area inductions for each employee. • All employees re-inducted every 3 years • Display and training on PPE requirements
9. Control of Records	• A list of identified safety documents maintained
10. Control of Documents	• MSDS's kept for all chemicals on site • Records kept of all licences and permits required for the site. • Safety communication/posters in place
11. Communication, Involvement and Motivation	• A process for identifying and controlling critical safety documents; audits and inspections.
12. Health and Hygiene	• Safety communication/posters on health. • Quarterly safety meetings on every site • Risk control plans communicated and displayed. • Safety notice board in place and correct content
13. Change Management	• Hygiene and monitoring program for each site • Site maintained in a clean presentable manner.
14. Contractor Management	• Risk assessment for all new plant and equipment. • Safety management plans for significant projects.

15. Monitoring and Measurement	• Permits in place for all legal requirements. • Induction to site and job for all employees. • JSEA's/SOP's for all tasks/activities of medium/high risk
16. Emergency Response	• Maintenance program for safety items • Safety Scorecard established. • LTIR, MTIR, Severity reported at each site.
17. Evaluation of Compliance	• Evacuation plans displayed • Evacuation schedule established • Minutes of evacuations kept
18. Incident Investigation, Corrective and Preventive Action	• Legal compliance audit on a periodic basis • List of all registered plant maintained • Permits in place for specific legislation and high risk activities
19. Rehabilitation and Return to Work	• All medical and lost time injuries have an incident investigation conducted.
20. Internal Audit	• RTW plans developed and updated • Monthly review of all existing open claims
21. Management Review	• Workplace/Hazard audits completed monthly • Internal Safety System audits completed annually • All Plant/Operations Managers involved in safety activities. • Management involvement in site safety audits

Table 6.1 Minimum Safety Standards

There are some very basic standards such as 'OH&S policy displayed and communicated'. The clauses of each standard also allows enough flexibility for sites and divisions to tailor it to their operations. For example, the safety policy can be displayed in the foyer or on safety notice boards and can be communicated through inductions, toolbox talks or communication meetings. By doing this, it creates enough flexibility to allow sites to take ownership also by coming up with innovative ways of meeting the standards. However, some standards still require procedures because of their importance to the overall safety management system (such as a risk assessment procedure).

The minimum standards then tie into the auditing and compliance program and as a basis for training. It is important to recognize the limitations of the minimum standards and to use them as leverage into the safety journey or plan (see Figure 6.2) and improvement to a total safety culture. A critical aspect of achieving the minimum standards is communication. One way to do this is through posters and communication sessions describing what they are and their purpose. Training and auditing must then follow, as on their own, policies they are simply another "policy that sits on the wall," that does not translate into action. A natural progression of the minimum standards is a safety toolkit. The safety toolkit is the more specific example on

how to meet the criteria with examples and forms and more procedures as required to meet the standards. A list of the forms and procedures in the safety toolkit is contained in Appendix 6.5.

There often is no logical connection between the safety policy, the detailed and complex safety system with all the procedures and forms and what was actually in practice. To overcome this issue, the safety system was summarized to several minimum standards that had to be met by every site and location as noted above. These were simple to understand and linked to the performance measurement as well. Auditing was conducted to this standard and sometimes certification. This resulted in a much greater knowledge and understanding of what was legally and physically required to be in place (see chapter 7 results and discussion).

6.3.6 Application 6: Employee Consultation

Background

Effective safety communication and consultation is critical to driving a good safety culture and improvement in an organisation. Safety is based around risk management and change management, standards acceptable even a few years ago are no longer acceptable today. Hence, safety is in a constant state of change. The success of many change programs is communication. Consultation is a type of communication that aims to create more feedback and improvement to engender ownership of safety improvements and controls of risks identified.

Action taken for employee consultation

Since communication can be in many forms, several types were taught and implemented in the organisation as follows:

(i) ***Verbal, direct face-to-face – Managers were asked to perform safety observations to the 'stop and think' approach noted earlier,*** such as asking someone to put on their hearing protection. The number of these observations was recorded and set as a performance measure in Visy.

(ii) ***Verbal, indirect through video or telephone link*** - Conference facilities were set up in major locations around the country and meeting such as a national safety steering committee

meeting, where people are in distant geographical locations, would connect up to each other through a video link.

(iii) ***Training*** **-** Through training many aspects of safety are communicated and is the principle method used. However, it is not always the best method depending on the outcome required. Training was carried out in a range of topics and areas as noted in the other practical applications.

(iv) Posters and displays in the workplace. **-** This is another communication mechanism that is promoted widely, however the effectiveness is still very hard to judge. This researcher has found posters have been effective in communicating a single message about a change or what is to take place rather than specifically changing behaviour. The 'stop and think' posters noted earlier are an example of what was implemented in practice in Visy.

(v) Safety signage **-** This is different to posters as they display a specific requirement such as a Personal Protective Equipment (PPE) requirement like hearing protection. However, again signage alone will not create a change in behaviour this has to be followed up with management supervision. In one factory in New Zealand a person who had a serious injury from not wearing PPE was used as an encouragement for other employees to wear their protection.

(vi) Safety Notice boards **-** Safety notice boards are often used to communicate safety requirements, such as displaying the safety policy or audit results. Safety notice boards were implemented at each site to a defined template.

(vii) Toolbox talks **-** Toolbox talks are a simple mechanism for communicating basic safety requirements and information. They are one of the most effective communication tools. They involve face-to-face contact with basic information presented. A toolbox talk should take about five minutes and can involve two way communication but is primary designed around one way communication. If the talk goes for too long, it becomes a safety meeting and is often moving outside the scope the intent (see Appendix 6.6). Toolbox talks were implemented and standardized as a performance measure as noted in chapter 8 in the scorecard.

(viii) Safety Committee Meetings - There is a balance between the content, level of discussion and control in a safety committee meeting (see Appendix 6.7). The main purpose is to consult with employee representatives in order to improve and solve safety issues. There has to be adequate two way communication and everyone gets equal opportunity to represent their respective workgroup. It is important that those attending a safety committee have been trained, so as there is a common language and understanding of the committee's purpose and legal obligations. Often it is only the designated workgroup representatives that are trained and not the management representatives. Safety committee meetings and records of them became a standard throughout Visy to improve the communication and resolution of actions, this was also included in the safety scorecard as a performance measure.

(ix) Management Meetings - It is important to ensure that safety becomes a part of the how the company operates when significant safety risks exist in its operations. Safety should not just be kept for safety committees but integrated into all meetings. In other words if there is a production, finance or any other functional meeting, safety should be on the agenda, this became a minimum standard throughout Visy over the 4 years of the study.

(x) Safety Activities - Often safety activities become a good communication mechanism as well as improving the safety of the task at hand. Examples of safety activities include: Risk assessments, Job Safety Analysis (JSA), Workplace Audits, System Audits and Safety Assessments. Even though these activities are not directly designed for safety communication, there is a lot of communication about safety during them which takes place.

(xi) Safety procedures and Standards - Safety procedures and standards themselves are a communication medium that tries to create a correct safe behaviour to agreed standards. The issue is that the written word is not the best way to improve or change safety behaviour. First, it is hard to constantly maintain the wording of the procedure to the current safe practices. Second, it is hard to continually update and train people to the current procedures or standards. To be effective this type of communication needs to be simple and to the point on what the exceptions are rather than specifying the exact requirements of the task. This can be done through an initial training process, when comprehensive training documents may be used. Often, the most effect safety procedures or standards could be simply an identification of the hazards on a machine.

In summary, there are many different types of safety communication mechanisms and approaches and there are many more which have not been discussed here. However, often it is implementation and delivery of the communication that becomes more critical than the information itself. Also, it becomes apparent that a range of communication mechanisms or mediums need to be used to effectively get a message across and change behaviour to improve safety. To get a simple message across, two or more communication techniques should be employed.

6.3.7 Application 7: Behaviour- Based Safety

Background

Behaviour-based safety which involves safety behaviour observations are another communication and consultation mechanism. In this process, a person observes another employee or group of employees' behaviour with respect to safety and provides them both positive and negative feedback that may or may not be recorded (see Appendix 6.8 for a recorded example). This approach should be implemented with caution as it involves judgment of other people's behaviour and can be very effective in improving safety or it can cause considerable fear and angst. There needs to be a high level of maturity in the workforce and the style and approach of the observer has to be unobtrusive and non-threatening.

For example, if a manager is observing an employee sorting sharp products on a production line, they realize they are not wearing any gloves. The wrong approach would be to either go up to them and say you must wear gloves and I am going to report this to your supervisor or report it without telling the employee. A better approach would be to go up to the person and ask them what job they are doing and explaining it must be a hard job. Then in discussion saying that the product is sharp and may cause cuts, are there any gloves available that you can wear that could help etc. Hence, getting in the person's situation first and understanding why they are not wearing gloves rather than condemning them. Behaviour-based safety can be a very effective technique to improve safety. The 'Stop and Think' campaign is a variation of this where common safety controls are identified by the workforce based on a simple set of key behaviours. Management is then trained on these and the way to approach and carry out observations to these behaviours, the measured number of these observations can be linked to improved safety performance based on the knowledge that is being communicated through the workplace. But such techniques are not very effective if implemented in a poor work

environment, hence the work environment needs to be in order first. This is addressed in application 8.

Action taken for behaviour-based safety

A behaviour-based safety program was developed for Visy to help raise the awareness and implementation of safety initiatives. The program involved safety observations using a "Stop and Think" approach as noted earlier to record and provide feedback on safety observed in the workplace. The observations were to be completed by management and included both positive and negative feedback. There was training carried out at several locations around the country at several key plants. Forty-eight managers in total were trained to the behaviour-based technique and they had a target of one observation per a month. The results of this approach were identified only in the overall improvement discussed in chapter 8. It was not measured at the individual plant level.

6.3.8 Application 8: Work Environment

Background

The physical work environment is critical to creating a good safety culture. It is often the physical changes that occur in the workplace that make a real difference. All the procedures, training, measures and auditing means very little if it does not physically change the environment that an operator works in and shows continuous improvement. The key measure for any effective safety program is measuring the continuous reduction of risks that workers are exposed to.

It is often hard to know where to start, a short conversation to a worker of ten minutes can produce a dozen activities and actions and thousands of dollars of cost and expenditure of improvement that can be done in a work environment. The key to identifying where to start is fully understand the risks within the physical environment. One must concentrate on the physical environment and identify any hazards or issues and assess the risks to determine a priority of action and then take action and start to make real changes to the environment (see section 6.3.4 on risk management earlier)

An audit should be carried out, not of the systems and processes, although that is part of it, more importantly the environment and the people working within it. The first step when

conducting auditing of a plant or a specific operation is to observe an area and discuss with employees so as to understand what they are doing regularly and identifying the risks and issues involved.

Getting to know and 'actively listening' to employees in the work environment is important. Then observe the physical environment employees are working in. One should use a hazard check list to consider all the physical risks and hazards which exist in the work environment. Consider what simple changes can be made to reduce the risks. Simple improvements to a work area would soon bring great results because it will cause a shift in the attitude of the people working there. A coat of paint and a few hand rails can make a huge difference on a work area and more importantly the people who work there. A simple tool to use for this is the 5S housekeeping and improvement program developed in Japan (Woolson, 1997) and contained in Appendix 6.9, it is a great way to improve the work environment, combining that with a risk management and communication program can vastly improve a workplace with improved safety and productivity. However, as stated, this needs to be combined with addressing other major underlying issues that have to be addressed also, such as the inherent high risks in the process or training and development issues and following up with auditing to maintain the standards of improvement and/or look for further improvement.

Action taken for work environment

Apart from all the activity around risk assessment and communication as noted earlier, two key initiatives were implemented to improve the safety and knowledge of safety in the work environment. These included housekeeping audits and workplace audits. Housekeeping audits were conducted on a weekly basis to ensure the workplace is maintained clean and tidy to reduce the risk of injury and improve productivity. Also, each month a more comprehensive workplace audit had to be completed by management of an area to ensure controls from risk assessments in the workplace are maintained in a good safe manner. These two audits included measures and requirements that had to be reported in the statistics on a monthly basis and hence produced the improvements reported in chapter 8 on the performance measures.

6.3.9 Application 9: Injury Notification

Background

Injury notification is important to communicate when an incident has occurred and what steps others in similar situations should take to prevent a re-occurrence. First, an incident notification is carried out and this is followed by a hazard alert as required. For an incident notification it is important to consider how the incident will be notified. Often an incident will occur on a factory floor. Upon implementation of this application the following key aspects were identified:

- The follow up on the notification and the level of resources required including a back-up and training on the system and processes used.
- The performance criteria to evaluate the effectiveness of the notification.
- The correct process flow and understanding of those involved in the notification.
- The level of external assistance required and when to initiate it, eg. Fire Brigade.
- The aspects of the notification that can be automated and how it can work.

All these issues need to be considered in the injury notification practical application. Monitoring the success and implementation of the notification is critical. Otherwise, false and incorrect data could be obtained, not giving a true reflection of safety in the workplace or distort the focus of safety programs with respect to injuries or incidents.

An incident notification can be very brief, it is simply to notify of an incident so relevant people can take further action as necessary. Notification can be in the form of a phone call or an email. The phone call should be used if the incident requires immediate action and is of a serious nature, eg. Fatality. The notification should have, but not be limited to the following information:

- Name of person(s) involved.
- Date and time of incident
- Briefly what happened.
- Immediate action taken
- Next steps, such as a complete investigation.

The terminology may vary but a safety alert is an injury notification that lets a wider audience know of what has occurred and what action others should take to prevent the incident from occurring in a similar situation in the future.

The main requirements of a safety alert based on experience of implementing this application are as follows:

1. Safety professional or designated manager to distribute the safety alert by electronic means and hard-copy display on noticeboards within the division. Then the central OHS unit of human resources to distribute more broadly as required.
2. Only be distributed if it can add value to another location so that they can learn and make changes at their location from the incident leading to eliminating the occurrence of the same incident or injury.
3. Should have a photo of the situation or task being performed.
4. Should not include any individual names for privacy reasons.
5. Just have the corrective action with at least three actions, no more than one that is focused on the person, actions should include immediate actions taken to reduce the risk in the short-term.
6. Corrective action should focus on root cause and contributing factors and sent with the alert.
7. Controls and corrective action should use the risk control hierarchy.
8. Emphasis should be on system improvements, not on personal blame, even for simple sprain/strain injuries.
9. The area supervisor in consultation with the safety professional should complete a safety alert.
10. A register of safety alerts for the site should be kept signifying the alert has been followed up on the site, signed by the plant/operations manager and safety representative. This will be audited as part of the minimum standards.

An example of a safety alert is given in Appendix 6.10.

Action taken for injury notification

Injury notification was not new to the company but the process and rigor had to be improved as it was very ad hoc. To improve this knowledge of the injuries, faster communication to the right people namely senior management was needed. Hence, the following was implemented:

A. A requirement that all injuries had to be reported on the computer system within 24hrs as an incident notification which was measured and reported.

B. There would be a communication and an escalation process for all significant incidents such as a safety alert generated by the OHS department and communication throughout the organisation. These were posted on notice boards by safety representatives.

C. The reporting requirement would be a performance measure linked to KPI's and accountability which was followed up by senior management and the Workers' Compensation Manager.

When these initiatives were put in place the number of incidents increased but the severity of the incident (hours lost per an injury) and response time improved significantly. This improved the overall safety performance of the organisation, particularly with respect to workers' compensation costs, as can be seen in the performance measure improvement reported in chapter 8.

6.3.10 Application 10: Incident/Accident Investigation

Background

A good incident investigation can drive continuous improvement in safety, however if an incident investigation is handled poorly, it can have a negative effect on the safety culture. The word "incident" rather than accident is preferred. Phil, a person who presented training for Visy, whom had a bad workplace accident and ended up in a wheel chair for life once said "I cannot comprehend that what happened to me was an "accident" as the cause was found and was a result of a series of failures which led to the incident". An accident implies that nothing could have been done to avoid it and it was purely 'bad luck'! However, if we concentrate on an 'incident', one automatically starts to think about the facts of the situation which led to the failure resulting in consequences. Also, by using the broader term, an incident could be an injury, near miss, spill or product damage. The main purpose of an incident investigation is to determine the cause of failure resulting in negative consequences so as to put controls or changes in place to prevent the incident from occurring again. Other key outcomes of an incident investigation identified by this researcher are:

- To emphasize the importance of safety to all employees,
- To determine the root cause of a failure,
- To determine immediate and long-term corrective action,

- To notify relevant people of the details of an incident,
- To preserve the facts of a serious injury,
- To gather information for legal purposes, and
- To better understand what actually happened.

An incident investigation can be broken down into three main phases:

Phase 1 – Gather Information

Phase 2 – Analyse Information

Phase 3 – Recommend Corrective Actions.

However, before even commencing an incident investigation, it is critical to first assist anyone involved in the incident, not just those injured but anyone that could have been affected by the incident, particularly if it was traumatic. For example, in an investigation of an incident where a person had their finger amputated, no-one had bothered to offer counselling or considered the effect of the first-aider who had to take an amputated finger and preserve it to take to the surgery. This can be important for a long time after the incident has occurred.

Action taken for injury/accident investigation

Incidents need to be properly investigated to ensure the knowledge of the cause of the incident is determined and to make sure a similar negative incident does not occur elsewhere in the company. Similar to the injury notification, the following was put in place in Visy:

A. A requirement to investigate all significant incidents (defined as medically treated or lost time injuries) including sign-off by the supervisor or manager in-charge of the area where the incident occurred.

B. A performance measure was put in place to compare the number of incidents that occurred and the number of incident investigations carried out. This was regularly discussed by senior management.

C. The incident investigation had to be reported to the division manager in a timely manner to ensure follow up and accountability.

D. A hazard alert was generated for all significant incidents that impacted elsewhere in the company and appropriately communicated, including a sign-off from the other areas that the alert had been considered and actioned.

This investigative approach required a complete new training program but once completed there were significant improvements in awareness and culture as identified in the second climate survey discussed in chapter 7.

6.3.11 Application 11: Safety Training

Background

The effectiveness of any safety system is largely dependent on the training carried out. It is the training that ensures consistent understanding and transfer of knowledge from a few professionals to many. Training has to be tailored to the audience for which the knowledge is to be transferred to, their current level of knowledge and ability to learn can greatly affect this transfer. The training should always be tailored to the specific audience and the desired outcome.

There are many different types of training but they can be classified into five common types as discussed below. Often a combination of different training types is used, depending on the safety program (Harris, Willis & Simons, 1998):

(i) On-the-job or buddy system – This is appropriate where a person is supervised by another person or 'buddy'. It is useful for specific job skills that require tools and equipment, allowing for immediate feedback and checks. Another advantage is that it does not involve removing the person from the job, work can continue. This approach tends to be informal and can create inconsistency, particularly if different trainers are used. It limits the number of participants and is a relatively cheap option. Allows the buddy to transfer particular skills and abilities that they can demonstrate.

(ii) Classroom - Formal delivery from a trainer to a group of people. Good for communicating a lot of information and wide range of presentation styles is available, can be made more interactive, but depends on the skills and knowledge of the trainer. Disadvantages can be that it is not interactive on-the-job, requires higher literacy and comprehension levels. However, it can allow for a larger amount of participants at once. Costs can vary significantly but generally more expensive, particularly if the costs of removing someone from the workplace are also taken into account.

(iii) Teamwork - This involves small teams working at once on a task that would normally only take one or two people, this allows someone to perform the task whilst others can observe and participate as appropriate. It is a combination of classroom and on-the-job training and has the benefits and disadvantages of both depending on the particular program.

(iv) Electronically or remotely - It enables information and training to be delivered to a very wide participants list at once. It can be very cost effective, however software and computer costs could increase the costs. Enables information and records to be obtained more easily, also to control the content of the information is similar to that of a classroom, but allows for updates more easily. Allows for a wide range of geographical locations also. Limitations are the control of who is actually doing the training, allows "cheating" to be easier, controlled access could also help and written confirmation may help but will start to reduce the benefits. Most effective for rather simple information not requiring particular on-the-job application such as those using powered tools.

(v) Self-paced - Where an individual is given course material to work through on their own over time. This can be a combination of the previous types, on-the-job and electronically and has the costs and benefits between those two types. Will depend on the skills and literacy and dedication of the person carrying out the training which will impact time frames of completion.

In summary, training is a wide ranging topic and too broad to fully cover here. Simply, it depends on many factors; such as knowledge of those receiving the training, what change is required, how much money is available for the training, what are the outcomes, etc. An overview was given here because training was a critical part of the transfer of safety knowledge.

Action taken for safety training

Many of the initiatives already mentioned to improve the knowledge transfer and safety performance required significant training. Hence a comprehensive training program represented in a training matrix was delivered throughout the organisation around Australia. However, the training was simplified into many smaller modules of 2-4 hours to reduce the productivity impact of people who are not at the worksite during the training. Training was also tailored to senior management, divisional requirements or site specific requirements. The training was competency-based, meaning that each session was completed with an assessment

which was recorded. Training was often done to the standards or the specific performance requirements such as injury notification or risk management with a strong emphasis on outcomes and the reason why the safety initiative was in place.

6.3.12 Application 12: Auditing and Compliance

Background

The aims of safety auditing and compliance may be varied but the main reasons are (adapted from Weinstein, 1997):

1. To ensure standardized approaches to working.
2. To check for legal compliance and understanding.
3. To share best practice.
4. To check compliance against agreed company standards.
5. As a training and development tool for those who participate.
6. To determine common risks and areas for improvement.

It is important that the style and approach to auditing ensures the best outcomes to the agreed objectives. Often audits are considered to be bureaucratic and 'policeman' like because auditing does not focus on the value-adding for those involved. It is important to assess to a standard criteria but to allow flexibility for individuals and the site to progressively move to an improved outcome, incremental improvements.

Most audits follow a common process involving eight steps: (based on work by Curran and Mahon, 2001)

1. *Scope* - The scope will determine the breadth and size of the audit, is the audit for a process, a site, a division or a company. Then what is the scale and size of the operation, how many people or machines? Who will be involved in the audit and what are the outcomes and expectations from both auditor and auditee.

2. *Criteria* - The criterion of the audit is one of the most important aspects to ensure the desired outcomes of an audit are achieved. The criteria should relate to the scope and purpose of the audit. For safety, it is often to improve the standards and practices on a site in order to reduce risk and create a safer workplace. Continuous improvement is an important aspect of an audit and should be reflected in the criteria.

3. *Pre-audit briefing* - This is to meet with the participants of the audit and to brief them on the audit, why it is to be done and what are the expected outcomes are. It is important at this stage to put each participant at ease and establish rapport. This will help with the conduct of the audit and allow a more accurate reflection of the system/process being audited.

4. *Audit and Evidence Gathering* - Conducting an audit is not always easy to do and requires a degree of skill and diplomacy. One must always consider being in the position of the auditee and be there to help them in their outcomes of their job. One needs to show that a win-win approach can be achieved when it comes to a safety audit. It is very important to emphasis good points and win over a person's trust first, identify processes that are operating well, positive re-enforcement. Whilst wanting to improve, one does not want to lose those actions that are currently being done that make the workplace safe.

5. *Follow up* - Sometimes it is not possible to gather all the evidence at the time of the audit. Hence, to allow the process to continue one may request the information be found and provided later. One may also be required to follow up with other people or areas not involved in the audit.

6. *Audit Debrief* - A quality audit will also involve a debrief with those involved and feedback to other management to identify how the audit went and what the next steps are. Were there any significant issues that needed addressing quickly identified during the audit? Also, what support and help can be provided to improve the safety in the workplace which the auditor can feedback to senior management This is a good opportunity to briefly show photos and hard evidence of good aspects and areas for improvement.

7. *Audit Report* - An audit report again must summarize all aspects mentioned above and include as a minimum: a summary of key findings, the criteria used, who was involved, detailed findings and evidence gathered. Again, one needs to keep in mind that an audit should help to continuously improve the safety for a process or workplace. It should clearly identify the actions required and explain why and how they will add value to

improving safety. Often a short concise report is better and more likely to be read and actioned than a comprehensive long one that drives managers to inaction by being overwhelmed by the problems.

8. *Audit Follow up* - It is critical that an audit is followed up to ensure action and improvement has taken place in a reasonable amount of time, otherwise the audit was not as effective as it could be.

Action taken for auditing and compliance

An extensive audit program was put in place using the eight steps method described above to measure each and every site to the minimum standards by an independent by trained auditor from another site. The audit report had actions that were tracked and followed up, including reporting back to senior management on close out of the actions raised in audits (see Appendix 6.11). These audits also included checks to legal requirements where appropriate, such as forklift licenses. Sites progressed from basic to detailed audits and in some cases to certification audits by an independent company. This ensured much greater legal compliance and understanding of safety requirements throughout the organisation, as demonstrated in the feedback and results of the second climate survey results presented in chapter 8. Often the photos from audits would be circulated around the organisation and in presentations again improving the awareness and accountability of issues.

6.3.13 Application 13: Measurement and Statistics

Background

To drive the safety improvement program, there needs to be a measure of the program to gauge performance. As it is commonly said "what is measured is what is done." Measurement and statistics also enable the organisation in a number of different ways, as identified in this research:

1. To determine a benchmark to gauge improvement.
2. To identify good performance that can be learnt and transferred.
3. To identify poor performance that needs a focused effort of resources and "target" areas where the greatest benefit can be obtained.
4. To allow a more open and honest measure of performance that all can see.
5. To enable further analysis for opportunities to improve.

6. To gauge success of specific programs and initiatives. For example, a measure of before and after a training program on incident investigation.
7. To demonstrate performance to all levels of the organisation so senior management are also aware. In other words, it can directly communicate performance of a particular plant to the CEO.

Hence, there are many advantages to performance measurement, however there can also be some pitfalls (also identified by this research):

1. If the measurement is not consistent it, can undermine the whole value of measurement all-together, such as the method for determining what is a lost time injury.
2. The measure may not cause a direct improvement in the desired outcome. For example, will measuring injury rates actually improve safety by reducing the number of injuries in the first place?
3. Manipulation of a measure to make a misrepresented improvement. For example, not reporting injuries to keep the measured number down to achieve a target that may be associated with a bonus.
4. Not comparing the measures relative to the environment. For example, comparing safety performance in an office environment to a labour intensive manufacturing environment is unrealistic.

Critical aspects to the success of the "safety scorecard" which is a safety version of the balanced scorecard (Kaplan & Norton, 1996) has also been advocated by many safety researches as well (Gallaghar, Underhill & Rimmer, 2003; Mearns, Whitaker & Flin, 2003; Cadieux, 2006). Based on this study, the following have been found to help drive the success of the safety performance measurement or scorecard in practice for different levels in the organisation as described below:

For the organisation as a whole:

- A range of positive (prevention measures such as risk assessments) and negative indicators used (such as number of injuries).
- Measures should include some dollar-based measures, such as, medical costs of injuries.
- Measures must be represented geographically or in accordance with organisational structure.

- Results must be of sufficient detail and explanation to enable action to take place for poor results.
- Need to ensure consistent understanding of definitions and link to desired actions.
- There should be communication on why the measure and how the measure is calculated.
- Communication on strategies, tools and techniques to improve performance, communication of how success was achieved.
- Identify achievable and realistic targets.
- Celebrate success and achievements whilst keeping sufficient pressure on underperformers.
- Allow time for the improvement to take place.
- Must be tied in with other programs and initiatives, measurement alone will not improve performance.

For senior management

- Involvement of all levels of the organisation of what the measures are with a focus on senior management.
- Senior management buy-in to drive accountability and improvement in the measures.
- Should be presented at an executive level regularly and discussed.

For site management:

- Measures should be discussed and actioned regularly.
- Performance and incentives should be linked to the measurement to drive ownership and accountability.

For employees:

- Measures must be distributed to all employees through safety notice boards.

Action taken for measurement and statistics

This investigation highlighted that a range of performance measures were needed. The following were selected based on the methodology (see chapter 3):

1. Lost Time Injury rate (number of full days lost for an injury per million hours worked).
2. The actual number of risk assessments completed by site for a given timeframe.

3. For risk control and improvement, the safety actions completed by site (workplace audits help to maintain risk controls as well).
4. For training, the number of toolbox talks completed by site.
5. For supervision, the number of workplace audits completed.
6. Incident investigations that have specific legal requirements with respect to injury notification.
7. On-time reporting of injuries, that is, injuries reported within 24 hours that may potentially result in lost time.
8. Employees on restricted duties but still at work.
9. Employees not at work due to a work related injury.
10. Significant injury frequency rate (Lost Time Injuries and Medically Treated Injuries)
11. All injury frequency rate (Lost Time, Medical and First Aid Injuries).
12. Workers' compensation premium per employee.
13. Workers' compensation claims costs per employee.
14. Severity rate, the number of hours lost divided by the number of injuries reported.

Detailed definitions of the safety scorecard measures are given in Appendix 8.1 and the safety scorecard reports and graphs are discussed in Chapter 8.

One of the biggest drivers for safety improvement achieved in this study was through performance measurement for the "safety scorecard". The 14 safety measures were used as noted above, they were reported from over 120 sites every month and presented graphically and in summary form to senior management. Results were also included in the company annual report. The results were a significant improvement in safety performance, as demonstrated by the measures and as discussed in Chapter 8.

6.3.14 Application 14: Injury Management

Background

Injury management is part of the full spectrum of a safety incident. Although the ultimate goal is to have no injuries in a safe workplace, injuries do occur. In Australia the rate of injuries has been decreasing in both severity and amount (ASCC, 2006). Injury management can be

considered as the process which manages the time from when a person is injured in the workplace to when they are back at work with no restrictions or ongoing treatment. Many injuries will never meet this state due to long-term effects of the injury such as amputations and permanent disabilities, and needs to be handled differently.

The way in which an injury is managed can have a significant impact on the workplace. Based on this research injury management can have an impact on the following:

- Relationship between employee and employer
- Relationship between the injured person and their family and friends.
- Relationship between the injured person and their other work colleagues.
- Recovery of the injured worker.
- Financial position of both the employee and employer on significant cases.
- The injured person's physical capabilities and quality of life.

An important aspect of injury management is the level of control and power and how it shifts when an injury occurs. In other words, before a person is injured management has the control and power over the workplace and the people working within it, within reason. Legislation is written in a way which gives employers most of the power and control before the injury. However, once a person is injured, the power shifts to the individual, a legal case supported this when the judge stated "I understand we are in a workers' paradise with respect to workers compensation" (Conciecao Vs. Visy Industries Pty. Ltd. 2006, NSW County Court). The reason being the legislation is written to provide complete protection for the worker and their entitlements with respect to a work-related injury (NSW Workers Compensation Act 2009). These comments follow more the intent of the different legislation rather than the specifics and particulars. This study focuses more on the workplace with respect to injury management rather than a legal, insurance or medical perspective. This is because the workplace more relates to the safety and safety management of the injured worker. Often in safety arenas the injury management is neglected as a separate area (AS4801, AS18001, 5 Star, see earlier section 6.3.5 on Safety Systems), however it can be argued that injury management should be part of the whole safety process and systems. Indeed, even in government, it is handled by different departments in each state.

Critical elements identified by this researcher of injury management with respect to the workplace and the worker are:

1. The time it take to immediately respond to the injury
2. The quality of the treatment of the injury
3. The amount and frequency of communication to the interested parties
4. How effectively the injured worker returns to work.

Action taken for injury management

As with many of the earlier practical applications, this one in practice included: measurement, training, support and a structured process. In this instance, to improve the injury management process with respect to follow-up in assisting injured employees, the process was outsourced to an independent company. This gave employees a sense of anonymity from the company and insurer and a better quality of service by those specialized in injury management. The results can be seen in the statistical improvement in safety performance measures and costs savings discussed in chapter 8.

6.3.15 Application 15: Health and Wellbeing

Background

There are an increasing amount of studies showing that this decrease in health is affecting people at work (Edmondson & Roloff, 2009):

- They are less productive, "presenteeism" is a new buzz word for being physically at work but not being as productive.
- There is more sick leave and absenteeism.
- When people get sick they are taking longer to get better.
- There are more health-related diseases.

All these factors are increasing the costs of injuries and decreasing the profitability of companies. Many employers are starting to understand that if they spend a little bit of money and time improving the health and wellbeing of employees the benefits to the bottom line are significant.

Hence, companies are realizing they need a health and wellbeing program but are unaware of the most effective way to improve health and wellbeing of employees. There are many

companies that have started in this area in the last decade; it is a significant growth area (Garber, 2000; Bertera, 1990). Based on this research the following questions should be considered before starting a health and wellbeing program:

a. What is the size of the company?
b. What type of workforce is there, white or blue collar?
c. What are current levels of activity in the workplace?
d. What is the geographical spread of the company?
e. What is the predominant gender of the workforce?
f. What types of ethnic and cultural backgrounds are there?

Once these more generic questions have been answered and considered, then more specific questions about the health and wellbeing program need to be considered:

- *How much money is the company willing to spend on the program?*
- *How will the success of the program be measured?*
- *What will be the duration of the program?*
- *How will it be managed?*
- *What is the target audience?*
- *Will the program be run externally or internally?*
- *Promotion and marketing of the program?*

Types of training in Health and Wellbeing

There are different types of training programs from those with high activity such as running events to more passive programs such as, information booklets and classroom education. It is recommended that a company begin with education before moving straight into physical activity, it will also encourage a wider range of participants. After all, employees' health is a very sensitive area and all care must be taken to protect employees' mental and indeed physical wellbeing. Many employees may not be ready for physical activity yet. However, as the program progresses the activity and range of activities could increase to maintain motivation levels.

Types of information in Health and Wellbeing

The types of information will depend on the actual program, target audience etc. It is suggested that a range of information be presented from media stories, hand-outs, information on

particular topics and risk areas, such as, heart attacks. It is important to both encourage participation and to educate, particularly by management.

Medical or physical measurements

A way to encourage people to participate is to first encourage them to attend a fully confidential medical; employees can then know exactly if they have a health issue. Confidentiality is critical, a program that was run over three years by this researcher, had only 30% take-up in the first year but increased to 70% over three years as employees gained confidence that the program was for their own benefit and not used by management to 'remove unhealthy people from the workforce'. When test results are reported back as an aggregate they should not break down to groups of less than 10 so that individual results cannot be determined. It is important to identify those in high risk categories that need other expert medical attention regardless of the program. As an example, in one program run, 340 employees did a medical examination and five employees found out they were in the high risk of type II diabetes and didn't even know it at the time of the examination and were treated early by independent expertise. This is a great benefit to the company and the person, it is a win-win approach that addresses problems before they become more severe. There are many measurements that can be taken, it is important to include physical and blood type measurement to cover a range of health measures.

Health and Wellbeing as a Strategy

Health and wellbeing can be part of the overall company strategy with respect to employees' safety and be seen as the precursor to safety management to reduce costs over time. This can be shown in Figure 6.3.

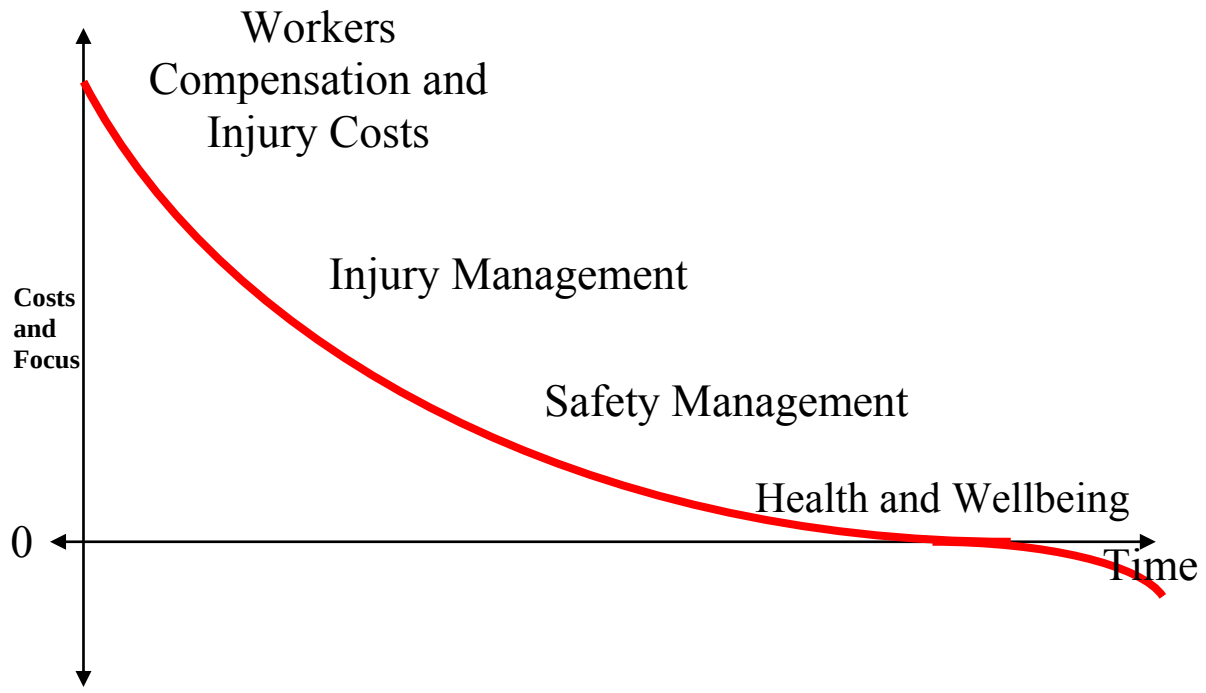


Figure 6.3: Health and Wellbeing and the relationship to Safety Management

The goal for most companies is to be profitable. One way profits are affected is by Workers' Compensation costs due to injuries in the workplace and these costs can be significant for any organisation. These costs could be reduced by improving the safety of the workplace, such as machine guarding. If even before the accident the employee's health is better, it is commonly known they heal better and may even be more productive. In one example in Visy, a person was compensated $360,000 dollars for a serious leg injury as the result of a workplace accident. The injury was caused by contact with moving parts of a machine due to a machine guard not being in place. But even more contributing to the costs was the excessive weight of the employee which only got worse when they were injured. It required a lot more time for them to be rehabilitated due to the weight being transferred to the injured leg. Hence, a health and wellbeing program could have reduced the costs of the injury significantly. Also, the employee was said to be rushing to get the job done. A health and wellbeing program could have helped firstly to manage stress and secondly, to help them be more productive in other aspects of their

work so they may not have had to rush. This example may be a "bit of a long bow" to equate injury to health and rehabilitation, however there are studies to support this (Medibank Private, 2005). Here in lies one of the barriers with running a health and wellbeing program.

Barriers to Health and Wellbeing programs

After reading the evidence, it may sound obvious that a health and wellbeing program should be implemented in every company. However, the money allocated to health and wellbeing by companies, although increasing, is still low, compared to safety directly or workers' compensation. One of the reasons for this is that it is hard to directly relate health and wellbeing to profits, it is not like producing a product, it is about people and their health and there can be so many other contributing factors. However, this researcher believes that this is a growing area and will eventually replace the safety emphasis in the future, as safety will become a given, health and wellbeing will become the emphasis and as a possible employee benefit in the future.

Action taken for health and wellbeing

This is another area, like injury management, that is not traditionally included in safety management and a safer system, however, again in this study it was proven as a good way to improve safety performance and culture. Employees felt the company was genuinely concerned about the employees' complete health and wellbeing, not just at work. Many initiatives were put in place at Visy including:

1. Free medical checks for staff by an independent practitioner.
2. A "health passport" for each staff member who chose to take part showing their results and how they compare to the norms and whether they are at risk or not of a health issue (See Appendix 6.12).
3. Specific programs tailored to sites such as eating habits for those working on night shifts or for stress management in some office areas.
4. Communication of health programs and initiatives through specific notice boards placed on sites and leaflets handed out.
5. Emails and newsletters to staff who chose to participate, disseminating health knowledge throughout the workforce and their families. In some cases, even partners were invited to take part, free of charge.

Many of these initiatives were outsourced to an independent contractor who had specialized dieticians etc. This allowed for greater knowledge to be used in the application, and to ensure

independence and confidentiality to gain the trust of the workers to encourage them to take part. The types of measurements that were taken and improvements that were made are shown in Figure 6.4 and 6.5 below. There were improvements in all measures and particularly in dietary habits, exercise and lifestyle which can have the greatest impact of the health of an employee. However, these measures can be considered subjective but the physical measured improvement like waist circumference, blood pressure and cholesterol cannot be disputed.

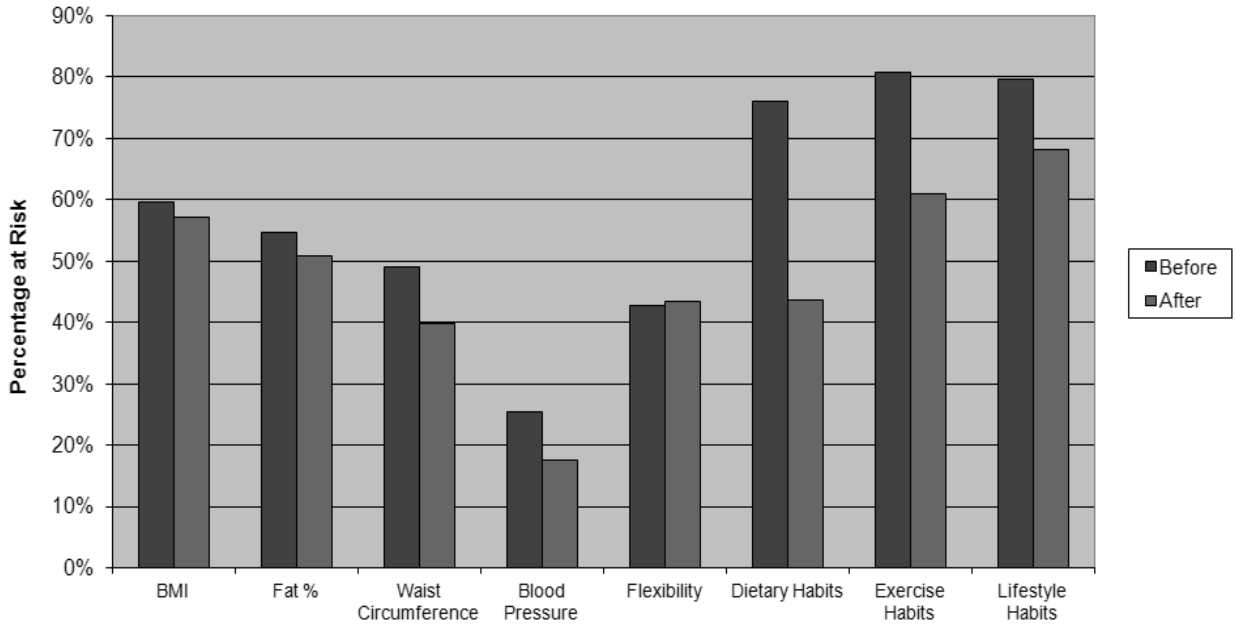


Figure 6.4: Health measures and improvements (Part I)

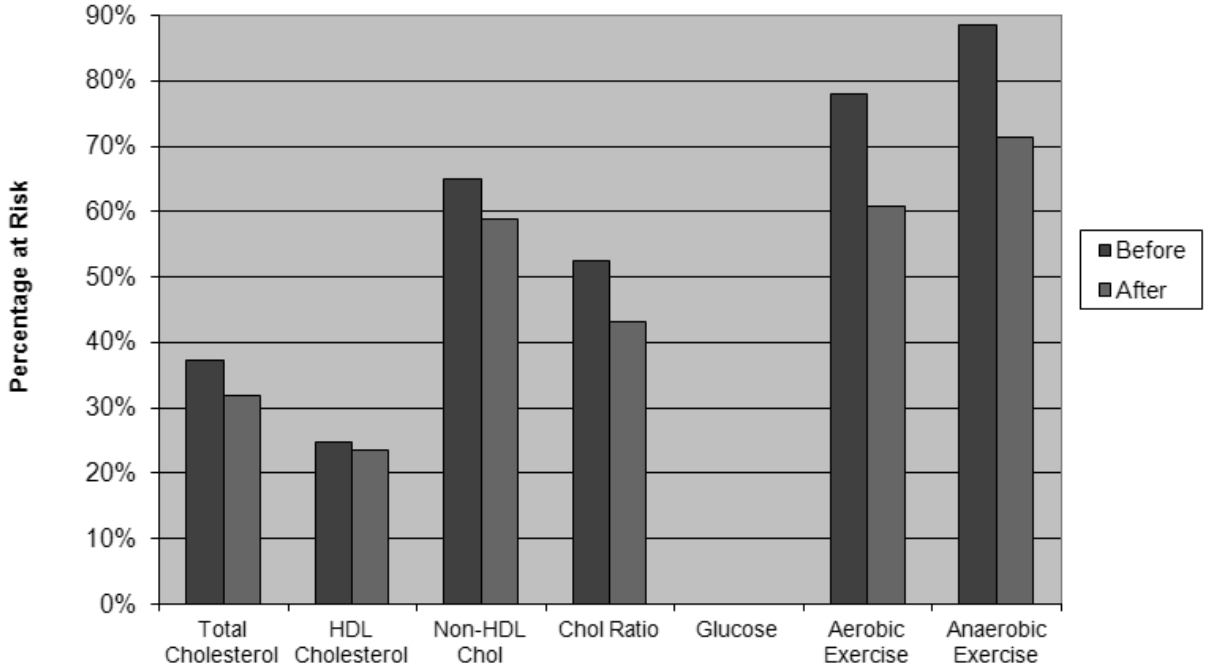


Figure 6.5: Health measures and improvements (Part II)

6.3.16 Application 16: Off-the-job Health and Safety

Background

The physical workplace and environment is critical to creating a good safety culture and much attention is focused there through Acts, Regulations and Standards. Rightfully so, as there are significant risks in the workplace. However, there is an area of risk that is often ignored by companies and that is the environment employees go home to live and play in. There are many specific programs targeted at the community and home environment, such as:

- Party Safe
- Pool Safe
- Office of Electrical Safety (however this is more focused at when a tradesman turns a home into a workplace by conducting work there).
- Office of Gas Safety
- Child Safe
- Local councils
- Local environmental laws
- Fire and disaster programs.

However, much of this activity is community based rather than companies promoting it. Several reasons for this to be considered by employees from this research are:

- Workers can have personal issues at home that affect them at work, such as not enough sleep when a new baby is born or a domestic dispute.
- Workers can get an injury at home which is then aggravated at work and can still become a valid claim (Workers Compensation Act 2000 NSW)
- Workers may carry out other activities at home that can affect them at work. In terms of fatigue an example would be watching sport on television all night at home then going to work for 12 hours at work.
- Workers' health can be affected more by what they do out of work hours in recreation time.
- Workers could be influenced by substances such as drugs and alcohol at home which can still be affecting their ability to work when they come to work.

Hence, there are many reasons to be concerned about the health and safety of workers 24 hours a day, not just whilst they are at work. However, one must also be careful not to be too imposing on a person's life and respect their privacy also. To influence the health and safety of workers outside of work the following strategies may be used:

1. A health and wellbeing program that looks at all aspects of a person's life.
2. Promotion of community campaigns through the workplace, such as healthy heart week, or national depression day etc.
3. Gifts that improve the safety at home, such as first aid kits for achieving a workplace safety milestone.
4. Employee assistance programs, which can provide counselling and support for employees during difficult times in their personal life.
5. Supporting sporting events that employees may participate in to improve the overall health and wellbeing of the workforce. This also helps for team building and communication in the workplace.
6. Free voluntary health or medical checks (see previous section).

It is important to consider what knowledge and resources are available when developing and implementing off-the-job health and safety programs. There are many Government and

community associations that will support and facilitate programs. Such as the Eye and Ear foundation has a lot of posters and information on eye safety and awareness, this information is often for free and a lot cheaper that trying to develop these in-house. Other ways can be simply by promotion, for example, an insurance company volunteered to distribute first aid kits with their company logo on them.

Action taken for off the job health and safety

Although not as extensive as many of the other initiatives, there were several programs run from Visy to communicate safety risks in the home. This included information from government and not-for-profit organisations such as "Beyond Blue" related to depression information or a presentation from the police on the dangers of driving during the Christmas periods. This again re-enforced the approach that the workers understood that the company was concerned for their overall health and wellbeing. In some cases workers were supported through programs even though they were injured at home.

6.4 Practical applications and the Data – Knowledge spectrum

Probst, Raub & Romhardt (2002) state the primary purpose is to convert data and information into knowledge within the organisation, as knowledge is where the action is carried out that will cause sustainable change and improvement. To do this, each practical application is assessed with respect to knowledge elements and where they exist on the data-information-knowledge spectrum:

DATA …….INFORMATION……KNOWLEDGE

Unstructured ……..… Structured

Isolated ……...…… Embedded

Context-independent ……..…...… Context dependent

Low behavioural control ……..…… High behavioural control

Symbols ……..… Cognitive patterns for action

Distinction ……..… Mastery/Capability

Each practical application is assessed as to whether it has unstructured or structured information. Unstructured information is not broken down into categories and subcategories for further analysis. For example, injury numbers are unstructured unless they have some detail on the type or location of injury or mechanism of the injury. Then, once the information has this break down, it becomes structured and can be useful to create knowledge for action. Isolated information means that the information exists separate and not linked to any processes or systems. For example, legal knowledge can be isolated in an online database that the company pays a subscription to, it is not until there is a process to ensure the review and implementation of the legal requirements that it becomes embedded. With respect to context, the information needs to be assessed as to whether it is independent or dependant on other factors. For example, safety performance numbers are not context dependent unless they are part of a measure of performance and assessment for those responsible. The level of behavioural control is important. For example, safety can have a high behavioural control in terms of how people act and respond around dangerous machinery or a low behavioural control in terms of a fool-proof machine guarding which cannot be bypassed. Symbols are just like pictures or 'wallpaper' unless they become a part of cognitive patterns for action. For example, a sign requiring the wearing of hearing protection is simply a symbol unless people are trained to understand that one is required to put on hearing protection. Finally, information can simply be a distinct element, unless it is understood and used to create mastery and capability. For example, four Lost Time Injuries can be good or bad, it depends on the knowledge and capability of the person analysing the numbers. If previously there were only two Lost Time Injuries, that is an increase which needs to be analysed for reasons and causes. Table 6.2 gives examples for each of the practical applications in terms of the Data – Information – Knowledge as described here.

Element	Data examples	Information examples	Knowledge examples
1. Legislation and Regulations	Specific legal requirements such as data on distances in machine guarding standards referenced in legislation.	Legislative requirements in acts and regulations.	Safety activities carried out in accordance with legal requirements and equipment installed to legal standards.
2. Safety leadership and culture	Senior management, Key Performance Indicators for safety.	Company policies and standards on safe behaviours, eg. OHS policy.	Activities carried out by senior management showing leadership in action and by example.
3. Safety strategy and action plan	Measures that go into strategy and action plans.	The actual safety strategy or journey and action plans.	Activities and processes implemented in accordance with strategy and specific plans.
4. Risk Analysis and Hierarchy	Risk scores and measures used to calculate scores.	Risk assessments and action plans from them.	Follow through on risk assessments in practice, actions carried out in the workplace.
5. Safety Systems	No specific data for this element, holds a combination of all other elements.	Safety system elements and processes as defined in documents.	Activities carried out in accordance with safety systems requirements and documented processes followed in action.
6. Employee Consultation	No specific data, could examine training completed and participants.	Procedures on consultation requirements, minutes of meetings, notice boards etc.	Effective safety consultation taking place on a regular basis and employees acting in accordance with information taught.
7. Behaviour based safety	Measured safety observations	Procedures and defined processes for behaviour based safety.	Safe behaviours carried out in practice in accordance with specified requirements.
8. Work Environment	Physical measurements of the workplace such as work bench height.	Information on workplace requirements such as standards and codes both internal and external to the organisation.	Physical condition of the work environment and how it is maintained in practice and the understanding of it.
9. Injury Notification	Injury statistics and databases.	Analysis of injury statistics, reports. Company and legal requirements defining injury notification.	Actions carried out based on analysis of reports, understanding of requirements and processes carried out in practice.
10. Incident/Accident Investigation	Uses injury statistics and databases.	Incident investigation procedures and reports.	Activities and actions changed and carried out in accordance with outcomes of investigations.
11. Safety Training	Safety training measures, participants, hours etc.	Safety records and training materials.	Activities carried out in accordance with training requirements.
12. Auditing and compliance	Measures of auditing, number of audits or action raised, closed, etc.	Auditing records and procedures of auditing requirements.	Actions and improvements carried out as a result of auditing action follow through.
13. Measurement and Statistics	Actual measurements and safety statistics.	Procedures defining measurements and statistics to ensure consistency and application, also analysis of measurements and statistics.	Improvements made as a result of analysis of statistics and measures, follow through on analyses.
14. Injury Management	Injury records and databases both internal and external.	Procedure and reports for injury management, return to work plans etc.	Activities carried out in accordance with injury information, reports etc.
15. Health and Wellbeing	Measurements and statistics on health and wellbeing, such as blood pressure levels, also HR data such as absenteeism.	Reports and finding on health and wellbeing analysis.	Knowledge of health put into practice such as physical activity.
16. Off the job health and safety	Injury information and statistics from off the job injuries.	Information reports and disseminated for off the job activities such as child safety in the home.	Activities carried out in accordance with disseminated information.

Table 6.2: Data, Information and the Knowledge Continuum for Safety Management

It is now understood how the practical applications exist in terms of knowledge. Next they are analysed in terms of knowledge transfer to help convert the applications into practice in the strategy. Knowledge transfer types are defined by Dixon (2000), this is covered in the next section.

6.5 Practical applications and knowledge transfer

Dixon (2000 and 2012) demonstrated that all knowledge is transferred in an organisation in five principle ways, those being Serial Transfer, Near Transfer, Far Transfer, Strategic Transfer and Expert Transfer (from Chapter2, section 2.3.4.3). Using the Knowledge examples in Table 6.2 for each of the practical applications, Table 6.3 on the next page analyses each in terms of knowledge type and transfer mechanisms or methods.

With the knowledge management understanding of the practical applications, it is now necessary to devise an implementation strategy. The next section explains how each of these methods or techniques have been implemented over time into the organisation that can then be analysed for performance to determine the success of the approach.

Element	Knowledge example	Knowledge transfer type	Transfer mechanism or method
1. Legislation and Regulations	Safety activities carried out in accordance with legal requirements and equipment installed to legal standards.	Serial, Near and Expert transfer	Safety Law Registry, Quarterly updates, Executive training, Risk Assessment before purchase.
2. Safety leadership and culture	Activities carried out by senior management showing leadership in action and by example.	Strategic Transfer	Safety structure, Safety Leadership Team and Divisional teams, involvement in safety activities, KPI in bonuses and targets, Conference on OHS.
3. Safety strategy and action plan	Activities and processes implemented in accordance with strategy and specific plans.	Strategic and Far Transfer	Safety strategy, divisional and site plans.
4. Risk Analysis and Hierarchy	Follow through on risk assessments in practice, actions carried out in the workplace.	Expert transfer	Training, Risk analysis at Purchase, Commissioning and Operation, Database, Risk analysis teams, Capex requirements, overall risk program.
5. Safety Systems	Activities carried out in accordance with safety systems requirements and documented processes followed in action.	Near and Expert Transfer	Minimum Standards, Safety toolkit, audits and training, Certificaition, Measures of the system, in practice in hazardous areas.
6. Employee Consultation	Effective safety consultation taking place on a regular basis and employees acting in accordance with information taught.	Serial and Near Transfer	Safety notice boards, toolbox talks, safety alerts, OHSE meetings, OHS Conference.
7. Behaviour based safety	Safe behaviours carried out in practice in accordance with specified requirements.	Far Transfer	Safety observations program, Stop and Think, Training, Positive Feedback.
8. Work Environment	Physical condition of the work environment and how it is maintained in practice and the understanding of it.	Serial and Near Transfer	Housekeeping audit, teams, and workplace audits, KPI Reporting.
9. Injury Notification	Actions carried out based on analysis of reports, understanding of requirements and processes carried out in practice.	Near and Far transfer	Injury recording database and notification mechanisms, Performance measure, 24hr response, escalation process.
10. Incident/Accident Investigation	Activities and actions changed and carried out in accordance with outcomes of investigations.	Serial and Expert Transfer	Incident investigations teams, reviews, reports, hazard alerts, reports to senior management.
11. Safety Training	Activities carried out in accordance with training requirements.	Serial, Near and Expert Transfer	Complete training programs for three levels, senior, divisional and site levels. Competency Based Training and target programs, Induction.
12. Auditing and compliance	Actions and improvements carried out as a result of auditing action follow through.	Near and Expert transfer	Audit program with cross site teams and area experts, database for actions and follow up, Certification.
13. Measurement and Statistics	Improvements made as a result of analysis of statistics and measures, follow through on analyses.	Serial and Near transfer	Safety scorecard with lagging and leading indicators, targets and performance measurement, graphically monthly.
14. Injury Management	Activities carried out in accordance with injury information, reports etc.	Far and Expert transfer	Measurement, training, coordination, structure and process, support.
15. Health and Wellbeing	Knowledge of health put into practice such as physical activity.	Strategic and Expert Transfer	Medical checks, health passports, training programs, information notice boards.
16. Off the job health and safety	Activities carried out in accordance with disseminated information.	Strategic and Expert Transfer	Information handed out and further support if injured off the job.

Table 6.3: Knowledge, transfer type and mechanism for safety management

6.6 Strategy of Implementation of Practical Applications

This study uses an action research based approach as practical applications are implemented in the organisation and analysed through performance measures. In order to make a sustained and manageable improvement, there needs to be significant resources and time allocated to a project or topic. Safety is no exception, however as there are always limited resources, a strategic implementation of the change needs to be developed. The strategic approach to this application of knowledge management to safety was based on a priority, first to create the greatest impact and improvement and then develop from there. The safety strategy is contained in section 6.3.3 and the more detailed plan is presented also in section 6.3.3.

The safety strategy begun with a vision which was developed through a serious of workshops with relevant safety professionals in the organisation, then a vision was developed for each strategic safety component which relate to the practical applications in this study. The central model used was the 5 C's model (Crisis, Control, Compliance, Commitment and Culture) created by Dupont, a leading safety organisation which is very well known for its superior safety performance. Crisis is when the organisation is simply responding to external pressures to make improvements such as a PIN (Prohibition Improvement Notice) by Worksafe. Control is where some measures and performance are implemented, however, they are still led by management who define the controls, not the employees. Compliance is where the procedures and standards are in place but it requires supervisors to constantly enforce them. In Commitment, supervision and management is not required constantly to re-enforce standards, employees understand and follow accordingly. In Culture there is more of a proactive response by employees where suggestions are made and followed through as part of the regular work, safety is integrated fully and not separate and actions are taken to improve safety constantly at all levels in the company.

At the beginning of this "journey", as it became known the organisation was in a Crisis/Control phase. Also laid on this diagram are the three core areas of OHS: Workers' Compensation, Safety Management and Health & Wellbeing. As improvement was made to the costs of each

area, the overall cost was reduced. The safety plan shows in detail how the practical applications were implemented as part of this study.

6.7 Summary of Chapter 6

This chapter introduced the practical applications and how they were developed. It then provides a summary of each of the practical applications and insights developed during their implementation. The applications were then analysed in terms of the Data-Knowledge spectrum and the knowledge transfer mechanisms developed by Dixon (2000). This then provided a basis to implement the practical applications through a strategic safety plan in the organisation over the three years from 2005 to 2008. The next chapter presents results of the second climate survey which was used to provide further evidence that of safety improvement by the application of knowledge management principles to safety.

CHAPTER 7

RESULTS OF CLIMATE SURVEY II

7.1 Introduction

The aim of the second climate survey conducted in late 2008 was to review the status of the safety culture in Visy to determine if there had been a significant improvement since climate survey I conducted three years earlier in 2005. Also, for the Visy organisation, there was a requirement to make recommendations on areas of improvement to drive the safety performance to the next level. As with climate survey I, data was collected by conducting phone interviews that were divided into a quantitative component (closed questions) and a qualitative component (open questions). The questions were the same as for the first survey with some additional requirements around the training aspects (see Appendix 7.1).

There were significant changes that had taken place in the organisation over the period 2005 to 2008. Firstly, there had been a large reduction in senior management from 42 down to 18 and similar changes had occurred in management and staff throughout the organisation. Coinciding with this was a major restructure of divisions reducing from six to five as shown below in Figure 7.1.

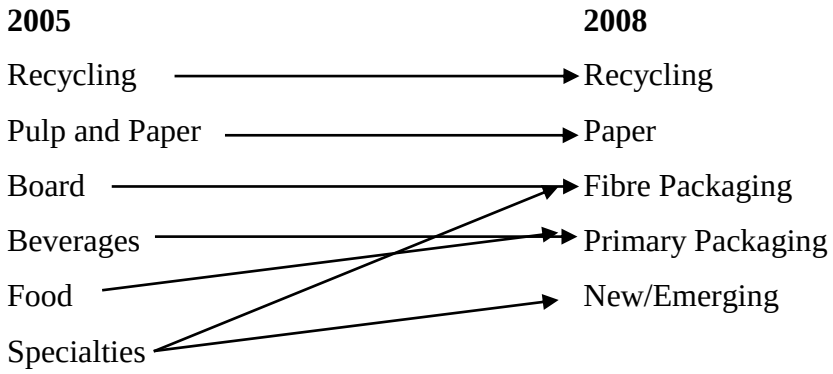


Figure 7.1: Change in Visy's organisation structure

Significant improvements in safety performance had been achieved over the 2005-2008 period as a result of the safety practical applications programs and initiatives introduced and discussed in the previous chapter. Significant injury rates were down by 60% and claims costs were

down by over 70%. More specifically, medically treated injury rates and lost time injury rates were down by 61% and 40% respectively. This translated into many benefits to the organisation, not least of which was significant savings - both directly and indirectly. Also, several of the recommendations made resulting from climate survey I had been implemented, such as the safety structure for each division, safety scorecard and safety training. There was a need to examine the impact of these changes in greater depth and hence climate survey II was carried out to determine if Visy's safety culture and systems had indeed improved.

Where possible, data was broken down into divisions and compared to the results obtained from the previous results. It is important to recognise that direct comparisons were limited by division due to major structural changes as discussed above and hence overall comparisons were preferred.

Improvements were identified in the following areas:

1. Safety Climate
2. Safety management
3. Safety communication
4. Safety commitment
5. Safety capabilities
6. Engagement in safety activities

Recommendations for further improvement were provided in the following areas:

1. Safety leadership
2. Safety training
3. Safety responsibility and accountability
4. Centralized functions
5. Budget restraints
6. Behaviour based safety

Each of these points is covered in more detail in the conclusion of the quantitative analysis and recommendation presented in section 7.5.

7.2 Quantitative Analysis

It was not possible to survey the whole of Visy, with over 5,000 full-time employees and 3,000 contractors used. Indeed, it is beyond the scope of this study to survey a significant number of shop-floor employees with such a diverse range of sites and locations (120 sites, ranging from 4 to over 300 employees). As this survey was a follow up to the previous one, some changes were necessary to cater for the requirements of Visy management. Most importantly was the fact that Visy was moving to a "one Visy" philosophy and approach by the CEO in that divisions would not be in silos as in the past. Under which, common functions were not to be repeated throughout the divisions, such as Marketing, Finance and Human Resources as was the case previously. This meant that individual divisional performance was not as critical to analyse as the overall Visy safety culture and systems. This allowed the sample size to be reduced which provided an overall view of performance improvement. The sample size was reduced from 120 to 44, however there was still an equal weighting of divisions achieved based on employee numbers. Also, at the request of Visy, a more detailed analysis of safety training was completed which is discussed in more detail below.

The quantitative, closed question data, presented in this section is dissected by division, namely: Paper, Recycling, Fibre Packaging, Primary Packaging, New/Emerging and the senior management team (Corporate). The structured questions, which will be reported on in this section included questions relating to safety climate, safety commitment, safety capabilities, engagement in safety activities and safety training.

Many of the safety performance measures show an increased improvement of up to 200%. Smaller improvements are tested to determine whether these are statistically significant or not. In order to do this, first the results were collated between the two climate surveys, this is contained in Appendix 7.3. They were analysed in terms of Safety Climate, Safety Engagement and Safety Commitment. Safety capability was not analysed as the results were very similar in both surveys in that individual believed themselves to be capable of performing the safety activities. The test of significance was using the t-test for equality of means based on equal and unequal variances and the results are contained in Appendices 7.4, 7.5 and 7.6, the raw numbers are also presented in Table 7.1 and 7.2.

7.2.1 Safety Climate

Safety climate provides a context in which managers can assess the acceptability of their behaviour in relation to organisational safety expectations. The assessment associated with organisational safety climate in this project covers five themes namely: safety management, safety standards, safety responsibility, safety communication and safety training, and are reported as an average score across several questions in each category. The mean scored for the various items presented below were calculated from the responses provided by the interviews on a scale where 1 = "strongly disagree", 2 = "disagree", 3 = "agree" and 4 = "strongly agree". The results are presented in Table 7.1 which provides mean scores for both 2005 and 2008 and graphically in Figure 7.1. The results for the Safety Climate dimensions dissected by Division are presented in Table 7.1.

	DIVISION														
	Corporate		**Fibre Packaging**		**New & Emerging**		**Paper**		**Primary Packaging**		**Recycling**		**Full Org.**		
	'08	'05	'08	'05	'08	'05	'08	'05	'08	'05	'08	'05	'08	'05	t-test
Safety Climate	**3.00**	**2.36**	**3.45**	**2.80**	**3.00**	**2.73**	**3.30**	**3.00**	**3.50**	**2.87**	**3.43**	**2.85**	**3.34**	**2.59**	**0.000**
Safety management	**2.80**	**2.82**	**3.27**	**2.94**	**2.75**	**2.73**	**3.30**	**3.00**	**3.60**	**2.92**	**3.43**	**2.95**	**3.27**	**2.88**	**0.000**
Safety standards	**2.30**	**2.00**	**2.45**	**2.79**	**2.50**	**2.80**	**2.60**	**3.00**	**2.60**	**3.09**	**2.57**	**2.85**	**2.52**	**2.88**	**0.000**
Safety communication	**2.80**	**2.36**	**3.15**	**3.06**	**3.25**	**3.07**	**3.30**	**3.00**	**3.50**	**3.13**	**3.57**	**3.11**	**3.29**	**3.06**	**0.056**
Safety responsibility	**2.80**	**2.54**	**3.09**	**3.06**	**2.75**	**2.93**	**2.90**	**3.00**	**3.00**	**3.16**	**2.86**	**3.11**	**2.93**	**2.92**	**0.148**
Safety training	**2.50**	**2.54**	**2.91**	**2.59**	**2.75**	**2.54**	**2.90**	**3.00**	**3.30**	**2.68**	**2.69**	**2.47**	**2.88**	**2.55**	**0.062**

Table 7.1: Mean Scores on Safety climate dimensions comparison between 2008 (n=44) and 2005 (n=120)
(Rating 1=Strongly Disagree, 2=Disagree, 3=Agree, 4=Strongly Agree)

Overall Perception of Visy's Safety Climate

The safety climate was measured in terms of safety professionals' and managers' perception of safety priority, performance and improvement from an overall perspective. The results show a mean score of 3.34 for safety climate, improving from 2.59 obtained in 2005. This is a positive finding that is highlighted in the overall results in that Visy's safety climate had significantly improved in the three years from 2005 to 2008. The 2 tailed t-test for equality of means confirms this with a result of 0.000, giving a statistical significance of 95% certainty (See Appendix 7.4).

Safety Management

The safety management category measures the managements' or supervisors' responsiveness, follow through and leadership on safety issues. The results show strong support in favour of safety management with a mean of 3.27 improving from a mean of 2.88 in 2005. The 2 tailed t-test for equality of means confirms this with a result of 0.000, giving a statistical significance of 95% certainty (See Appendix 7.4).

Safety Standards

Several questions assessed the perceptions of the standards of performance and behaviour established and accepted within Visy. The mean score of 2.52 for the 2008 survey is worse than the 2005 survey result (mean of 2.88), indicating a poor result with respect to safety standards. Looking more closely at the particular questions, there is a concern that short cuts are taken to get the job done and the company is responsive to incidents after they occur. This is an area for improvement and forms part of the recommendations from the study. The 2 tailed t-test for equality of means again confirms this with a result of 0.000, giving a statistical significance of 95% certainty (See Appendix 7.4).

Safety Communication

Safety communication is concerned with the level of and frequency of safety communication within Visy. Overall, interviewees agreed favourably with the level of safety communication with a mean of 3.29 up from 3.06 in 2005. The 2 tailed t-test for equality of means gives a result of 0.171 for equal variances and 0.148 for unequal variances, indicating that even though there was an improvement it was not statistically significant (see Appendix 7.4).

Responsibility for Safety

Responsibility for safety measured respondents' perception of whether safety is everyone's responsibility and the level of responsibility and the influence the individual has in the workplace. The results show little change with a mean of 2.93 for 2008 and 2.92 for 2005. The 2 tailed t-test for equality of means gives a result of 0.139 for equal variances and 0.056 for unequal variances, indicating there was little change and it was not statistically significant (See Appendix 7.4).

Safety Training

Safety Training measured the level of training received and its effectiveness within Visy. Although an improvement is identified over the three year period (mean of 2.88 in 2008 and a mean of 2.55 in 2005), the results suggest that there is still considerable room for improvement in this area. It would appear that the importance placed on safety training within Visy is poor. However, examining the capability results presented later in this chapter suggest that the improvement may be due to the skills that individuals bring to the organisation compared with three years earlier, indicating that the skills of the new employees hired into Visy are greater with respect to safety, than in the past. . The 2 tailed t-test for equality of means gives a result of 0.082 for equal variances and 0.062 for unequal variances, indicating that even though there was an improvement it was not statistically significant (See Appendix 7.4).

7.2.2 Safety Commitment

As with the 2005 survey, perceived levels of safety commitment were assessed using four questions namely;

(i) commitment toward OHS improvement by the individual,

(ii) commitment of Visy senior management toward OHS improvement,

(iii) commitment of plant managers and leaders toward OHS improvement, and

(iv) commitment of Visy employees generally toward OHS improvement.

Each interviewee was asked to rate the perceived level of safety commitment of the different levels of the organisation as follows; 1 = 'uncommitted', 2 = 'committed', 3 = 'moderately committed' and 4 = 'extremely committed'. The results are presented below in Table 7.2. Statistical analysis was done using the two sided t-test for equality of means, the results are

contained in Appendix 7.5. For a change to be statistically significant at the 95% confidence level the significance should be less than 0.05.

DIVISION															
	Corporate		Fibre Packaging		New & Emerging		Paper		Primary Packaging		Recycling		Full Org.		t-test
	'08	'05	'08	'05	'08	'05	'08	'05	'08	'05	'08	'05	'08	'05	
Self-commitment	**3.3**	**3.42**	**3.82**	**3.8**	**3.75**	**3.59**	**3.9**	**4**	**3.9**	**3.6**	**3.86**	**3.77**	**3.79**	**3.64**	**0.103**
Senior management commitment	**2.3**	**2.82**	**2.97**	**3.27**	**3.25**	**2.59**	**3.5**	**4**	**3.1**	**3.2**	**2.71**	**3.08**	**3.01**	**3.04**	**0.441**
Plant management commitment	**2.8**	**2.73**	**3.37**	**2.99**	**2.5**	**2.93**	**3.4**	**3**	**3.5**	**3.33**	**3.43**	**3.42**	**3.24**	**3.16**	**0.441**
Employee commitment	**2.8**	**3.27**	**2.36**	**3.26**	**3**	**2.74**	**2.9**	**3**	**2.7**	**2.79**	**2.71**	**2.81**	**2.68**	**2.76**	**0.301**

Table 7.2: Mean Scores on Safety Commitment – comparison between 2008 (n=44) and 2005 (n=120)
(Rating 1=Strongly Disagree, 2=Disagree, 3=Agree, 4=Strongly Agree)

With respect to the commitment of the individual, the mean score of 3.79 for 2008 is a slight improvement on the 2005 mean score of 3.64, this difference was not statistically significant. This improvement is also supported in the qualitative analysis with most respondents stating an improvement in safety awareness.

The 2008 mean score of 3.01 for the level of commitment of Visy senior management toward OHS improvement is slightly down from the 2005 survey result of 3.04 indicating that the perception of senior management's commitment to safety has not improved over the three year period and hence not statistical significant improvement either. This is a major finding which needs to be addressed and will form part of the recommendations.

The level of commitment of plant managers and leaders toward OHS shows a slight improvement from a mean of 3.16 in 2005 to 3.24 in 2008, however, this was not statistically significant.

Finally, when respondents were asked to describe the level of commitment of Visy employees generally toward OHS improvement, again, the perceptions of interviewees was that the employee group still have a high degree of those uncommitted (a mean of 2.68 compared with a mean of 2.76 obtained three years earlier), this was not statistically significant though.

7.2.3 Safety Capabilities

Safety capability is concerned with the level of confidence individuals had in undertaking various fundamental safety activities. These activities are the basis of any OHS system or program and are derived from the Occupational Health and Safety Act requirements in most jurisdictions. Capability was assessed by asking individuals their perception of whether they could take part in or perform each of the six safety activities as a yes/no answer which was then converted into a percentage of positive response. The results are represented graphically in Figure 7.2.

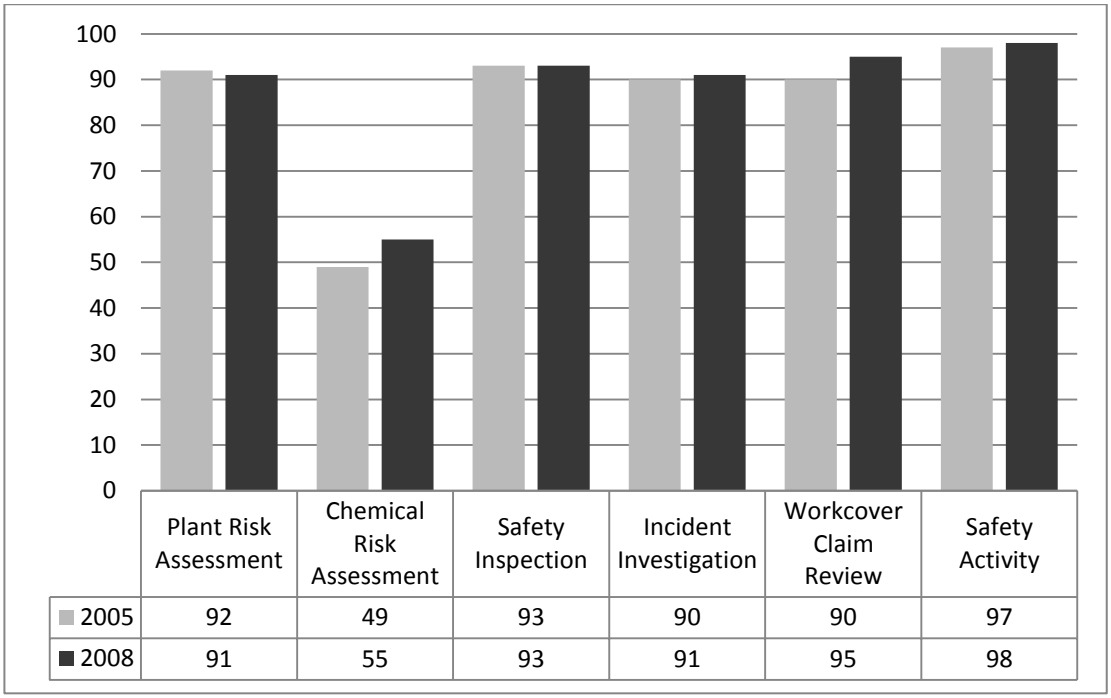


Figure 7.2: Safety Capability Assessment; 2008 (n=44) vs 2005 (n=120) (percentage of respondents)

Except for chemical risk assessment, over 90% of the respondents indicated that they had the capability to conduct plant risk assessments, safety inspections, incident investigations, a Workcover claim review and a safety initiative. Just over one half indicated they had capabilities to undertake a chemical risk assessment. These results indicate a high level of safety skills amongst this group in the organisation. However, this was expected since one-half of the respondents held a safety role or significant safety responsibilities. This represents a limitation in the study and resulting analysis. In examining the detailed results by division, no significant differences were identified and hence only the overall results are discussed.

The highest response was for conducting a safety activity or initiative to improve safety on a site with 98% indicating this capability. This high result is due to the general knowledge of safety amongst the target group and that safety activity in itself is a rather broad term, from giving out a reward or recognition right through to a whole behaviour-based program. Only 55% of those interviewed indicated capability in chemical risk assessment. This indicates that either knowledge of chemicals and its management was low in the organisation or that chemical risk assessment was perceived to be a complex task requiring particular skills and expertise. Qualitative data in the open ended questions suggests that this is a combination of both of these factors. Respondents indicated issues such as hygiene, monitoring, chemical exposures and standards which can be very complex. Nevertheless, the result indicates that the level of chemical management and knowledge within Visy needed to be improved.

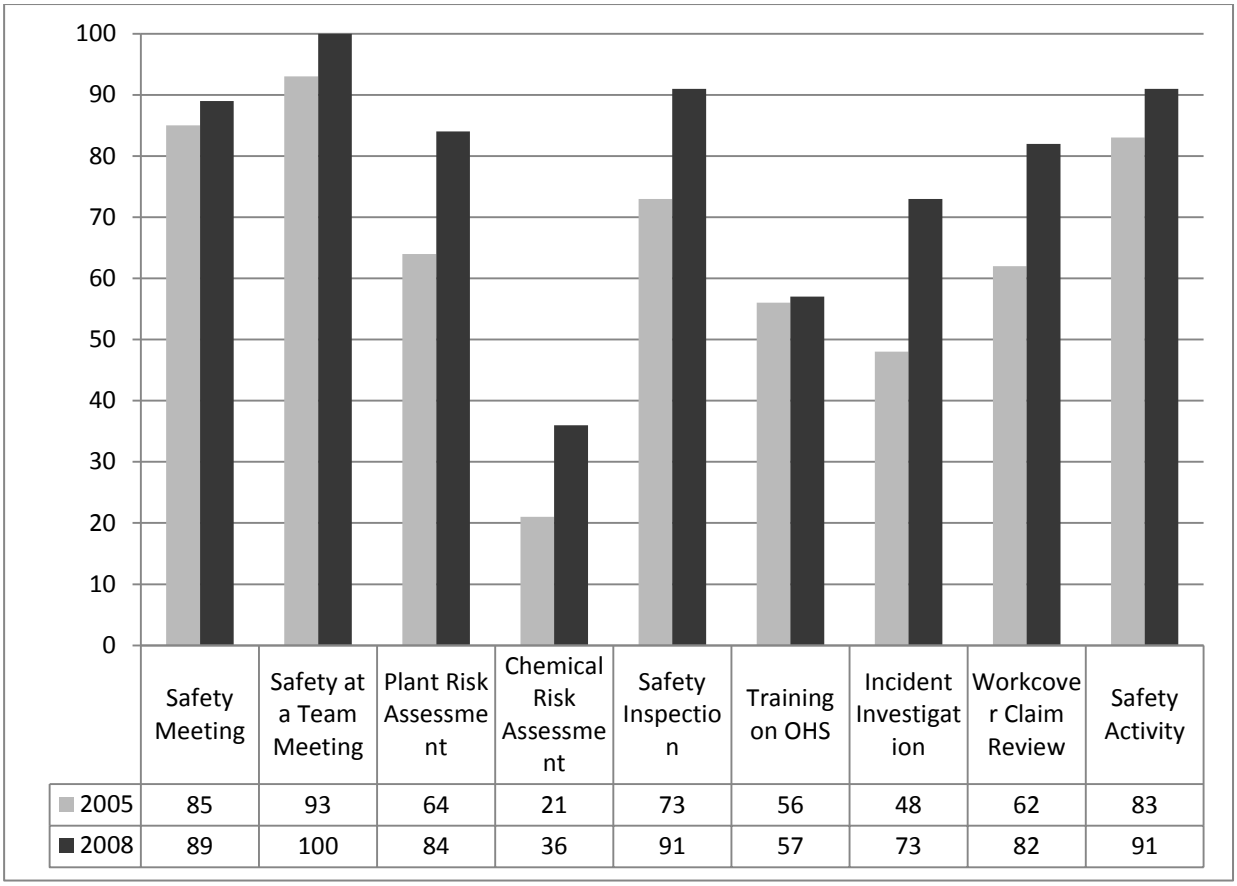
Comparing the results from the 2005 and 2008 surveys, there is only a slight improvement. With high capability identified to begin with, this is not a concern. However, one needs to acknowledge that some of the activities would not be the responsibility or requirement of certain positions. For example a General Manager would not be expected to be capable of conducting a plant risk assessment in any real detail. The only noticeable increase from previous results is in the capability to be involved in a Workcover claim review, up to 95% from 90% three years earlier. According to the national workers' compensation manager from Visy "this may be due to the training and increased knowledge of workers' compensation that exists in the workforce compared to three years ago". Answers to other open ended questions of qualitative data concur with this.

7.2.4 Engagement in Safety Activities

Although the previous section reveals that safety capability amongst managers and professionals is high, a more critical aspect is the extent to which they actually perform the various activities. Many authors identify safety leadership involves "leadership by example." (Krause, Hidley & Hudson, 1990) Also, in support of this, legislation now demands that management demonstrate an understanding of the safety risks in their area of responsibility by direct engagement in activities (Commonwealth OHS Act, 2011). In that, directors (senior officers) would not be able to rely solely on executives and managers' assurances of OHS compliance, but would need to satisfy themselves of corporate and individual compliance via informal reviews and audits of OHS management systems. The Victorian OHS Act includes specific offences for senior officers. Sections 144 and 145 of the Act establish that "a senior officer can be found guilty of an offence if there has been a failure to take reasonable care".

Hence, a critical part of this survey was to assess management engagement in OHS activities over the previous six month period. These results are presented in Figure 7.3 and show considerable improvement in engagement in all activities from 2005 to 2008. The results are in Appendix 7.3 and statistical analysis in Appendix 7.6.

The increase is significant and as high as 20% for some activities. In the 2008 survey 89% indicated that they attended safety committee meetings, compared with 85% reported in 2005, this was not statistically significant. With respect to discussing safety at a work team meeting, this had increased from 93% in 2005 to 100% in 2008, however, again this was not statistically significant. Engagement in a plant and equipment risk assessment exercise had increased from 64% in 2005 to 84% in 2008. This was statistically significant at the 95% confidence interval with variances considered equal or not. This improvement increase was largely due to an increased focus in this area through the implementation of the safety scorecard which gave targets for this element in every plant around the country. Further improvement can be made in this respect, particularly engaging senior management who feel that it was not their duty to be involved in such activities.



	Safety Meeting	Safety at a Team Meeting	Plant Risk Assessment	Chemical Risk Assessment	Safety Inspection	Training on OHS	Incident Investigation	Workcover Claim Review	Safety Activity
2005	85	93	64	21	73	56	48	62	83
2008	89	100	84	36	91	57	73	82	91

Figure 7.3: Engagement in Safety Activities: 2008 (n=44) vs 2005 (n=120) (percentage of responses)

In the previous section it was reported that only 55% of those interviewed had capability to undertake a chemical risk assessment. In terms of their engagement in this activity, a significant improvement is recorded, from 21% in 2005 to 36% in 2008, this was also statistically significant at the 95% confidence level. Of significance is that many of the work environments do not have significant chemical exposures that require a chemical risk assessment.

Engagement in conducting safety inspections had increased from 73% reported in 2005 to 91% in 2008. This was also statistically significant at the 95% confidence level, variances assumed equal or not. This significant increase can also be attributed to the safety scorecard implemented which included workplace inspections as a critical performance measure.

Respondents were asked if they had attended training on some aspect of OHS. The results show little improvement, 57% reported in 2008 compared with 56% in 2005, this was not statistically significant. This indicates that safety training was an area lacking in Visy and was a key recommendation for improvement.

Respondents were asked if they had conducted an incident investigation of any medical or lost time injury with 73% indicating that they had done so. This compares with 48% reported in 2005 and was statistically significant at the 95% confidence level, variance assumed equal or not. This substantial increase is largely due to the safety scorecard measurement and targets set for each plant. Also, training had been conducted in this area and improved reporting with online systems universally implemented.

With respect to Workcover claims review, 82% of respondents indicated that they had been involved in this activity, increasing from 62% in 2005. This was also statistically proven at the 95% confidence level variances assumed equal or not. This is a key finding and not necessarily attributed to the implementation of the safety scorecard directly. This is a positive increase that may also be attributed to the whole workers compensation and injury management program improvements such as increased resources, increased reporting, increased awareness, uniform standards and measures implemented across the country and increased engagement of financial and other business units in this critical activity.

Finally, interviewees were asked if they had organised a safety activity or initiative with the aim of improving plant OHS and 91% indicated that they had, up from 83% reported in 2005. Although an increase and a very good result, the increase was not statistically significant.

In summary, in the majority of instances respondents perceived themselves to be capable, and were more involved in safety activities in 2008 than reported in the 2005 climate survey and six out of nine safety activities were proven statistically to have improved. There had been a substantial improvement in most activities, particularly, those tracked and monitored in the safety scorecard, indicating the success of this initiative. However, there was still room for improvement indicated in most activities. Training was an area identified as needing significant improvement and had changed little since the 2005 survey. This is discussed in more detail in the next section.

7.2.5 Safety Training

The final section of the 2008 climate survey collected additional data relating to actual safety training. With reference to several key safety training requirements, interviewees were asked whether they had done the specific training and if yes, when this had been completed. Figure 7.4 presents the results with respect to the type of safety training completed. As noted in section 7.2.4, on average only 57% of respondents had stated that they had been involved in safety training in the last six months.

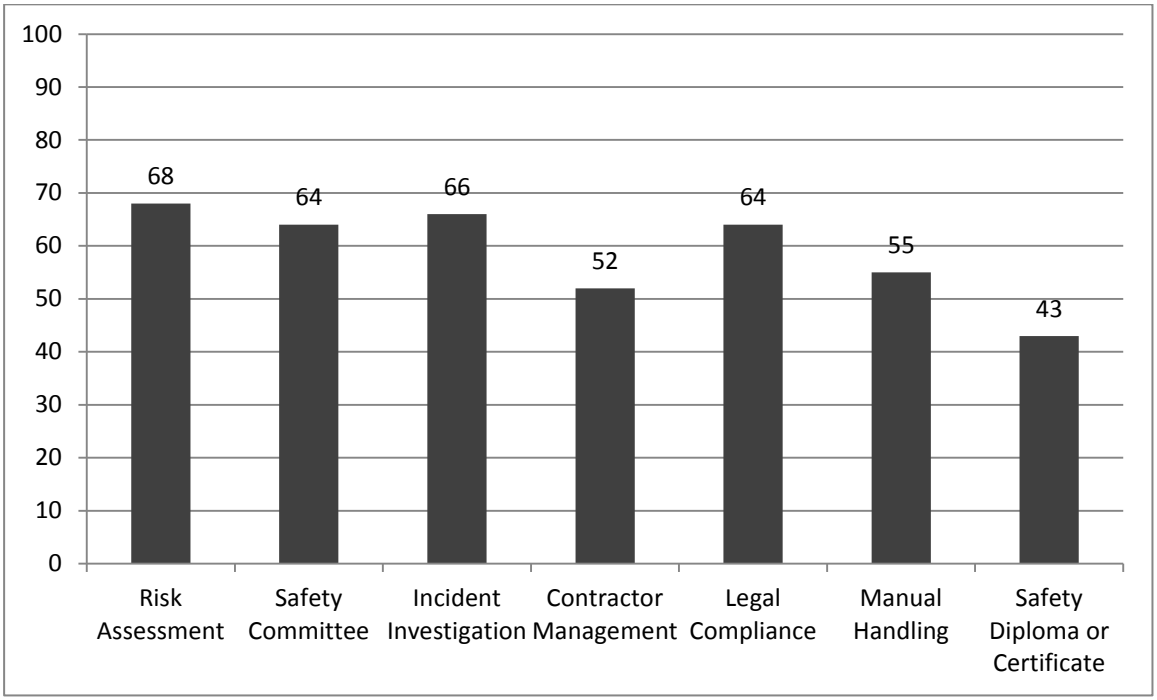


Figure 7.4: Safety Training Completed - Climate Survey II (2008, n=44) (percentage of responses)

Around two-thirds of the interviewees had completed training in risk assessment, incident investigation and legal compliance. This can perhaps be attributed to the corporate training offered in these areas across the company. Just under two-thirds of the respondents had also completed safety committee training. This was expected to be higher as it is stipulated in legislation and particularly those participating in regular safety committees would be aware of this requirement. Contractor management training had only just commenced in 2008 across certain areas of the company, which could account for a low result of 52%. Manual handling

training had been completed by 55% of the respondents and based on qualitative responses provided, this appears to be done on an ad-hoc basis only. Although this is seen as a critical area, it was not offered uniformly across the company but rather on a plant by plant basis.

Finally, only 43% of the respondents indicated that they had a formal qualification in safety. This is not a significant concern since only safety professionals would be expected to hold formal qualifications in safety rather than management which made up 50% of the respondents. Excluding management, 96% of all safety professionals surveyed held a formal safety qualification.

Examining the results in more detail, at least five or more people have been trained in every activity in the last three years (the time frame for which this study takes place). Furthermore, over 70% have received some form of training in OHS in the last three years. This would suggest that safety training is being conducted in some parts or divisions of Visy, regularly, however the training is not being utilized across the whole company. Hence there is a "silo mentality" with respect to training across the company, alternatively it would suggest that the training is not being enforced or encouraged but rather an option as to whether one attends safety training or not.

7.3 Qualitative Analysis of Open-Ended Questions

The qualitative instrument utilised for this research was developed using OHS Best Practice principles and adapted to investigate the specific OHS needs of Visy Industries. The instrument is included at Appendix 7.1. The following changes were made since the 2005 survey as discussed in section 7.1:

1. The number of divisions had reduced and names changed, as noted earlier, hence the divisions analysed in this survey were: Fibre Packaging, Primary Packaging, Paper, Recycling, New/Emerging and Corporate or senior management.
2. Some questions had to be reworded as an OHS strategy had already been implemented.
3. The company had changed some providers of services, such as for rehabilitation services.
4. The 2008 survey focused in more depth on aspects of training.

The purpose of the series of open-ended questions included in the phone interviews as to identify any major issues facing the various Visy divisions. Responses were recorded and later transcribed for analysis. Below are presented the overall results from the analysis relating to the nine questions asked. More detailed results are presented in Appendix 7.2.

Strategic Development

A comprehensive OHS strategy had been implemented across the organisation over the period 2005-2008. The first question addressed was:

1. *Visy has implemented a safety strategy in recent years, have you seen a change in OHS in your area over this time?*

There was a common response of acknowledgement that the strategy had made a significant improvement in safety, with commitment from the top and physical activities that took place on a regular basis. The improvement was aided by consistency and the sharing of best practices. Quotes such as "The leadership and aspiration required in safety has improved substantially" support this.

Barriers for Improvement

In the 2005 survey a number of issues were raised as to the reasons why it was difficult to improve safety, such as lack of resources and time, lack of understanding and training and lack of commitment by management, Hence the second question:

2. *What do you see as being the barriers to further improvement in OHS?*

There was a range of responses given to this question including, in order of most common:

1. Middle management commitment lacking still
2. Concerns that complacency would set in to higher performing areas
3. Resources and financial capital being a barrier to further improvement
4. The level of employee engagement was seen as a barrier
5. Safety performance linked to management performance was still required in some areas
6. More work to be done with respect to unification across the business as a whole

Control and Influence

The 2005 Climate Survey I included a question relating to responsibility. Hence a question exploring issues with respect to control and influence was included in the 2008 survey namely:

3. *How much control do you believe you have over your work environment to make changes to health and safety standards?*

Most respondents believed that they had a high level of control and influence, however there was still an acknowledgement of the position of authority they were in to affect as to what extent, for example a general manager would have more power and influence because of their accountability and authority of a general manager position.

Involvement

A number of comments on commitment were made in the 2005 survey towards management and staff, for example: "Safety is about everyone. Right now, safety is viewed as the responsibility of a few key people as opposed to everyone." To better understand what activities were actually carried out with respect to commitment, the following question was asked in the 2008 survey:

4. *What types of behaviours or activities do you engage in to make such changes (to OHS)?*

The safety scorecard was seen as the main vehicle that engaged employees in safety activities. These included activities such as: risk assessments, housekeeping audits, training, toolbox talks and OHS meetings. It was often noted that management played a key role in demonstrating correct behaviours and involvement. In other areas it was acknowledged that engagement by all levels of the organisation was critical and had improved.

Improvement to Training

Training was identified as an issue of concern in the 2005 survey, for example a comment like "I've done external training, but I've done no OH&S training within Visy and nor have I been invited." To ensure that training targeted the correct behaviours, the following question was addressed in the 2008 survey:

5. *What kinds of steps has Visy management taken to ensure that you are trained sufficiently enough to understand the expectations of OHS behaviours?*

There was a strong agreement that training had improved significantly and some of the formal training, such as a nationally accredited certificate in OHS was acknowledged. However, there was still a need identified for consistency in application across Visy and the content of the training across the organisation.

Changes to Legislation

Legislation is the basis for much of the policy and activities around OHS. Legislation is continually changing and it is critical to understand the latest changes and developments. Hence, the following question was addressed in the 2008 survey:

6. Are you aware of any changes to the OHS Act in your state?

Acknowledgement was given to the new sources of information such as online information, Safetylaw directory, safety alerts and informative emails. There were still issues raised as to how the changes communicated are being followed through by the divisions and organisation as a whole.

Most Significant Risks

Risk is still seen legislatively as the basis of most safety programs and indeed, legislation developed by state governments. Hence the risk profile of the organisation remains an issue. More importantly, it is important/critical to identify the most significant risks rather than all risks that exist within the work environment. Hence, the following question was addressed in the 2008 survey:

7. Can you name two or three of the significant risks in your work environment?

There was a consistent response in the understanding of risks and the significant risks identified included in order of frequency:

1. Machine guarding on plant and equipment
2. Manual handling and lifting associated with products
3. Forklifts and pedestrians traffic management risks
4. Inductions and the content and accuracy for new employees
5. Chemicals and their handling in order to reduce the risks of chemical injuries
6. Lock out procedures to ensure equipment is safe to do maintenance on
7. Aging workforce and the issues associated with physical work as workers get older
8. Maintenance activities and the increased risks during such activities, like working at heights.
9. Contractor management and managing the risks associated with contractor work.

These responses were similar to the previous survey, however in the 2008 survey the knowledge and understanding of employees was greater and there was more of a system focus to managing the risks associated with these activities.

Ways to Improve

Continuous improvement is a critical part of OHS and the raising of standards from one year to the next and importantly how the individual felt this improvement can be carried out, hence the following question:

8. If you could do two things to improve health and safety within your immediate workplace, what would they be?

There was a range of responses given in order of most common to least they were:

1. Traffic management plans up to date and in place to reduce risks
2. Capital projects to have more money available for safety improvements
3. More safety leadership by involvement of senior management
4. Enforcing performance measures as performance measures for management
5. Behaviour based safety programs to encourage positive correct behaviours for safety
6. Common standards associated with significant risk, eg. Guarding
7. Engineering solutions such as GPS systems in vehicles for tracking speed which can cause accidents

As with question seven above, the responses to question eight also highlighted a greater knowledge and understanding of OHS risks and processes by those interviewed.

Allocation of Resources

Over the three years from 2005 to 2008, Visy had undergone considerable change in terms of its structure and available resources and this was continuing. The final question was asked to determine the use and balance of central verses decentralized resources:

9. Within your workplace, if you have a Workcover/OHS issue, who would you contact?

The responses were consistent in this area with site safety professionals utilized and if they could not manage the issue or needed greater understanding, it was referred to the central resources. Identifying that there is a role to play for both centralized and decentralized resources in managing Workcover/OHS issues. Some respondents still mentioned a lack of resources but acknowledged the improvement that had taken place since the 2005 survey.

Based on the results presented above, a number of conclusions were reached and a set of recommendations presented to the senior management of the company. These recommendations were also integrated into the knowledge approach taken by this study. The next section presents these conclusions and recommendations.

7.4 Summary of the Findings of Climate Survey II and Recommendations

Visy had made significant improvements in safety over the three years from 2005 to 2008 both in measures of performance and with respect to culture and systems. The key improvements made were:

(i) The overall perception of Visy's **safety climate**, in terms of safety priority, performance and improvement increased by 40% to 100% agreeing that this was the case.

(ii) **Safety management** in terms of responsiveness, follow-through and leadership significantly improved, those 'strongly agreeing' increasing from 5% to 36% and those 'disagreeing' halved.

(iii) There was a significant improvement with respect to **safety communication** with those 'strongly agreeing' increasing from 17% to 43%.

(iv) With respect to **safety commitment** and people's perception of commitment of different levels of the organisation. Personal commitment increased from 68% to 84%. The level of safety commitment perceived by plant management staff increased to 81% and with respect to employees in general, the levels of commitment increased to 84% . This was an area for further improvement.

(v) **Capabilities** to perform safety activities had improved slightly overall. Except for chemical assessment which would not be applicable in all areas or sites, 90% or over of those interviewed indicated that they had relevant capability.

(vi) The largest improvements revealed by the study were in the area of **engagement in safety activities**. This is a critical aspect of any good safety management system and organisational culture. The most significant improvements were: safety discussed at a team meeting up to 100%, plant and equipment risk assessment up by 20% to 84%, safety inspections up by 18% to 73%, incident investigations up by 25% to 73% and Workcover claim reviews up by 20% to 82%. These improvements have come about as a result of many changes, With the most important being the implementation of the safety scorecard.

Areas for improvement identified were:

(i) Almost one half (48%) of those interviewed disagreed with the **safety standards** of behaviour established and accepted within Visy. In particular, there was a perception that the company has more concern with safety after significant incidents had occurred. This may also be a reflection of people's expectations of safety standards being higher than three years earlier. Hence, management need to ensure that safety is communicated constantly as a number one priority.

(ii) Although there was an improvement with respect to the level and effectiveness of **safety training** in Visy, just over one-quarter (27%) were still in disagreement, many indicating that the importance of safety training in Visy was poor.

(iii) Disappointingly, management and safety professionals' perception of senior management's level of **safety commitment** had dropped slightly over the three year period. This indicates that more work needs to be done to ensure senior management demonstrate their commitment to safety at all times. This can be achieved through safety leadership training and enforcing accountabilities and performance indicators.

(iv) In the area of **engagement in safety activities**, training was rated low in both surveys with just over one-half (57%) of those interviewed indicating that they had been involved in training over the previous six months.

The following recommendations are made based on the qualitative in-depth interviews and quantitative analysis, recognising the limitations and scope of this study, some aspects may need to be investigated further, nevertheless these would form the basis of the next step in the safety journey:

1. ***Safety Leadership*** – It was identified by several interviewees that leadership could be improved with respect to leadership behaviours and measures of performance, KPI's. This was also identified in the quantitative analysis where the perceived commitment of senior management had dropped slightly. It was recommended that more training be carried out for the senior management on what constitutes leadership behaviours and actions. These should be followed through with specific measurable actions and activities. Examples would include: site inspections, attending safety meetings, leading incident investigations and delivering safety messages.
2. ***Training*** – Training was mentioned as a major flaw by many interviewees, There needed to be more targeted and specific training provided to address basic safety

knowledge requirements such as risk assessments and incident investigations. Behaviour-based training should be provided for supervisors and middle management. Minimum skills and requirements should be developed for those with safety responsibilities. For example, all safety professionals should have an accredited Certificate IV in safety or equivalent, if they do not have it at commencement of their job they should be actively seeking it. Training needed to be focused towards building knowledge with respect to the specific activities and skills in safety that needed to be developed.

3. ***Responsibility and Accountability*** – In addition to providing training for knowledge and skills development, there needed to be a clearer understanding of each person's responsibility and accountability in safety with respect to their position in the company through position descriptions. This is from the very basic understanding that everyone has the right to stop a task or machine they consider unsafe to the more complex that senior managers are accountable for safety performance in their division.

4. ***Centralized functions*** – With respect to centralised processes and systems, these were well received by the many smaller sites and locations where there are fewer safety professionals and financial resources. However, some concerns were raised that such functions should not introduce too much bureaucracy and administration. Further analysis needed to be done to determine which functions need to be centralized and the value they will add to the sites. These should be as simple and basic as possible, reducing any administrative burden on sites. An example of this is the centralisation of the workers compensation administration function.

5. ***Budget restraints*** – There will always be budget and resource restraints but efforts need to be made to ensure these are not at the compromise of the importance of safety. One way this could be achieved is to allow capital expenditure to be reviewed based on risk not just on return-on-investment. There was also the need to have a separate budget for safety risks that may exist across the whole company. This requires a central risk management system or database to undertake risk analysis on a company-wide basis.

6. ***Behaviour-based safety*** – Many of the high performing sites expressed a concern over complacency setting in or systems and processes slipping backwards. This was also a

conclusion reached from the quantitative analysis (closed questions) which identified concerns relating to accepted safety standards at Visy. One way to address this is to introduce behaviour-based safety programs that examine systems and behaviours before incidents occur and addressing those through a leadership style training program in the company.

7.6 Summary of Chapter 7

This chapter presented the results of climate survey II completed in late 2008, covering both qualitative (open-ended questions) and quantitative (closed questions) aspects. The results also incorporated a comparison between climate survey II and climate survey I, conducted in 2005, three years earlier. There were positive improvements identified for most categories covered in the survey. The results were then used to develop further recommendations for future improvement in the organisation. The next chapter presents a discussion of the complete research undertaken including results of both surveys and practical applications implemented to answer the overall research question.

CHAPTER 8

DISCUSSION

This chapter examines the findings and outcomes of the research. Firstly, a revisit of the need for the study in terms of the current performance and why this particular research is needed. Section 8.2 discusses the exploratory study which was used to set the initial framework for the application of knowledge management to safety. In section 8.3 a discussion is presented of the first climate study and findings which set the benchmark for future measurement. Section 8.4 articulates the practical applications undertaken as a result of this study. Section 8.5 then examines the performance measurement used through this study. Section 8.6 then discusses the findings and outcomes of the second climate survey and in particular provides a comparison with the finding of first climate study. Section 8.6 details the concluding remarks and the last section discusses a framework recommendation from this study. This then leads to the conclusion, principle findings and recommendations of this study.

8.1 Current state and Performance

Safety is a very current topic in society at large as it impacts on so many lives and has very broad implications. The financial cost is significant, with estimates of $20 billion annually within Australia, not to mention the hundreds of lives lost every year. This is larger than the road toll and more people lose their lives at work every year than those lost in every bush fire in Australia in the last 50 years combined (Ellis, 2004). It is very important to understand not only lives lost but the thousands that are permanently injured and disabled from an injury at work. Not only the physical injury but also the mental and physiological injuries as a result of work environments and conditions. In Australia, the number of full and part-time employees with a mental illness is 17.8% (ABS, 1997) and rising (Dewa, Goering, Lin and Patterson, 2002). There has been an improvement in performance in recent years (Stewart-Crompton, 2003). Yet there is still a great opportunity and need to improve well beyond the current state. None of these statistics measure the true cost to society, "*all the friends and relatives affected by the consequences of an injured person both financially and mentally*" (Berger: 2006: 15).

One way to improve this safety performance is through legislation (Sherriff, 2010). However, legislation has been in effect since the early 1980's and yet still the number of injuries and cost to society remains high. There has been improvement, but the level of improvement is not

acceptable and further improvements need to be made, as each and every life and livelihood is valuable. Besides, many researchers in the area argue that this legislative approach does not produce sustainable long-term safety improvements and creates too much paperwork (Douglas, 2008).

Another means of achieving improvement is through investment in new technologies to provide a safer work environment and again this has produced a significant improvement at work. However, technology alone will not always eliminate work related injuries and the type and nature of injuries may change, such as repetitive strain injuries associated with using computers. Technology which can be used to remove physical injuries can create a sedentary workforce which can lead to other types of injuries, particularly in Australia with an aging workforce. (Edmondson & Roloff, 2009)

Safety is a very broad topic and varies in every industry and sector as work environments can vary significantly. This study primarily focused on the manufacturing sector and where relevant, related sectors such as transport and chemical industries.

8.2 Exploratory Phase

As noted above, the focus of this study is the manufacturing industry. In particular, the exploratory phase focused on a glass manufacturing company. This is a very high risk sector of the manufacturing industry where safety has a high importance, yet significant injuries still occur too often. The company manages three core float glass manufacturing plants and 36 distribution warehouses. There were two case studies carried out, the first examined the hazardous exposure to carcinogenic fibres, whilst the second examined the removal of prescribed environmental waste.

The first case study demonstrated how the use of knowledge (with limited resources) can produce a positive "win-win" type outcome, where safety is improved and costs reduced. In this study two employees were removed from their normal production duties and dedicated to developing a better insulation against heat (the existing one had carcinogenic issues). Combining their knowledge with external materials and research, they were able to develop a non-carcinogenic, more efficient and cheaper alternative.

The second case study examined alternative ways of disposing of a prescribed waste from the manufacturing operation. By using knowledge and ideas from other industries and sectors, a small team found that the waste could be used as a base in concrete mix.

From these simple, yet practical applications of knowledge management approaches, the following principles were developed by this researcher in practice:

1. Expand capabilities of the workplace – build and develop the employees knowledge through training and development.
2. Utilising internal and external resources – use external resources, such as government agencies for recycling or using internal resources such as trade unions.
3. Create entrepreneurial activity in the workplace – allow employees to do experiments and projects in a supervised environment.
4. Gain enthusiasm and drive support – encourage employees to participate in initiatives through management support such as recognition in an open forum.
5. Allow time for reflection and learning as part of regular work – employees and management should be allowed time to reflect and work on improvements to their work rather than just being too busy doing day-to-day tasks.
6. Establish horizontal teams in the organisation – assemble project teams that have representatives from different areas of the organisation, eg. production, purchasing and management.
7. Allow risk taking to help generate new ideas and concepts – allow employees to take controlled risks with minimal negative consequences.
8. Develop problem solving skills and expertise – include as a part of an employees' development problem solving skills and expertise.
9. Focus on value adding activities while considering the 'big picture' – carefully select activities that specifically add value to the organisation (in the complete sense of the word, such as safety improvement, not just financial) and reflect across the organisation.

10. Recognition and reward – acknowledge and reward employees during and at the completion of a project, using both financial, and tangible award forums e.g. noticeboards, certificates and ceremonies.

Based on these initial findings, it was then appropriate to re-examine the literature to determine if there could be a model or framework which could incorporate such principles and applied more broadly. Initially, it was difficult to find literature with an appropriate model because the models were either safety and systems focused or knowledge management and database focused. There was, in general, a gap in the literature that focused specifically on the application of knowledge management to safety. Hence, a knowledge management framework for safety was developed, see Figure 4.8 in Chapter 4.

This framework was then applied in a major multinational organisation to test the rigour and validity (through safety performance measures) and to test the research question that the application of knowledge management principles to safety management can improve safety performance.

8.3 Climate Survey 1 Findings

The first climate survey was a significant study for the organisation. It was the most significant management study ever done in the Visy organisation and required significant time and resources. In general the results suggested that employees perceived Visy as under-performing in the area of safety management. Also, the perception was that the leadership and management of safety at all levels could improve. There were strong indications that safety training was very poor and a further reflection of the lack of commitment by management in general. There was, in particular, a high degree of variation both within and between divisions. In summary, the key findings are as follows:

1. Resources - There was a lack of resources to drive the safety improvement and performance, not only in personnel but also in terms of systems and processes.
2. Training - There was a lack of safety training and skills, in general emphasising the need for the development of safety knowledge in the company.
3. Expertise - There was not enough specific safety expertise within the company across all divisions. Where there was expertise, it was very thinly applied with many of those allocated safety responsibilities having multiple roles and tasks.

4. Communication - There was poor communication and dissemination of safety knowledge and information, leading to a critical lack in responsibility and ownership for safety.
5. Safety measurement - The reporting of safety performance was very retrospective, based on post injury actions, injury rates and workers compensation costs, suggesting more proactive measures could be adopted.
6. Knowledge exchange - In line with communication there was a lack of safety knowledge exchange between safety professionals and managers.
7. Action - There was an acknowledgement that safety culture change was occurring but that it had not yet reached right down to the physical work environment.

In conclusion, Climate Survey I showed that there was significant room for improvement in safety at Visy and that there was a willingness by management and employees to accept and take on a change. Upon further examination, it was found that while there was considerable information available at Visy, it was not converted into knowledge. The next step undertaken was a series of practical implementations that acted as the core application of knowledge management principles to safety management, and ultimately to test for performance improvement.

8.4 Practical Applications

The main component of the study generated a series of practical applications for which knowledge management principles can be applied to safety. The 16 practical applications were incorporated into a strategic plan for Visy. More detail on the practical applications are presented in Chapter 6. They are listed here for easy reference:

1. Legislation and Regulations
2. Safety Leadership and Culture
3. Safety Strategy and Action Plans
4. Risk Analysis and Hierarchy
5. Safety Systems
6. Employee Consultation
7. Behaviour Based Safety

8. Work Environment

9. Injury Notification

10. Incident/Accident Investigation

11. Safety Training

12. Auditing and Compliance

13. Measurement and Statistics

14. Injury Management

15. Health and Wellbeing

16. Off the job Health and Safety

Over the period 2005-2008 these safety initiatives (applications) were implemented and were generally ongoing once implemented or improved. Further data collection and analysis was carried out using performance measurement to test the research question with respect to improvement.

8.5 Performance Measurement

In order to determine whether the application of the knowledge management approach was successful, continuous measurement was taken. The performance measures as discussed in the methodology chapter were incorporated into a safety scorecard. (More detail can be found in the practical applications in Chapter 6). The definition of each performance measure is provided in Chapter 3, section 3.3.7 and more information is presented in Appendix 8.1. The performance measurement was carried out each month and collated in the central incident reporting database. Audits were also carried out on all sites over the three year period to check the integrity of the data entered by sites. For the purpose of this analysis, and given the study was conducted over three years, only an annual snapshot was taken. The scorecards were reported in July 2005, July 2006, July 2007 and July 2008 (See Appendix 8.2 and 8.3 for the first and last report used for analysis in Table 8.1)

A summary of the overall organisation performance over the three years of the study is provided in Table 8.1.

Measure	2005	2006	2007	2008	%Change
Lost Time Injury Rate	18.18	13.17	10.37	10.97	-40
Medically treated injury rate	40	48.59	48.72	15.76	-61
All Injury Frequency Rate	138.34	162.85	193.04	202.03	46
Severity Rate	34.1	34.43	27.83	18.33	-46
Employees on Return to work plans	61	48	66	80	31
Employees not at work due to injury	32	15	6	16	-50
On time reporting of injuries (%)	82	90	93	94	15
Workers compensation costs per employee	$2,729	$2,524	$2,591	$3,058	12
Workers compensation medical costs	$1,055	$954	$1,357	$1,473	40
Number of risk assessments completed	223	331	472	899	303
Number of workplace audits completed	176	287	493	870	394
Number of safety actions completed	1349	2029	2447	552	-59
Number of toolbox talks completed	170	321	473	869	411
Number of incident investigations completed	65	142	165	214	229

Table 8.1: Summary of safety performance over the 3 years of the study (2005 to 2008).

Table 8.1 is divided into three parts, injury statistics, injury management measures and proactive or leading safety indicators, each will be examined in succession.

As can be seen from Table 8.1 above the significant injuries in terms of medical and lost time injuries decreased significantly by 61% and 40% respectively, however the all injury rate had increased by 46%. The all injury rate includes all three types of injuries, Lost Time, Medically Treated and First Aid Treated injuries. The reporting of minor injuries is good in terms of the accident triangle (Heinrich, 1931), because it is better to treat a minor injury before it becomes more severe. Examining the detail of the scorecards in the appendices (8.2 and 8.3) it is noted that the number of first aid treatments reported for the last 12 months from the survey had increased from 926 to 2,306. Finally, the severity rate had significantly decreased by 46% indicating that the average number of hours lost per reported injury has nearly halved.

Examining the injury management measures is a little more complex. Firstly, those on return to work plans increased by 31%, and this is not necessarily bad as one would rather have an employee being rehabilitated rather than not at work at all. However, being on restricted duties would be even better, so there was still room for improvement. Employees not at work due to a work related injury decreased by 50%, this was a positive result and indicates both better injury management in getting people back to work, and/or less severe injuries that require a worker to be off work in the first place. Another positive result was the on-time reporting of injuries

(within 24 hours of the injury occurring) which had increased steadily over the years to 94%. The workers compensation medical costs had increased by 12% and 40% respectively. However, workers compensation is complex and changes occur continually because of state and federal legislation, and also due to increased charges by governments seeking to recover the great losses in this area. Examining the comparison of workers compensation costs as a percentage of wages (or remuneration) relative to the industry and wages rather than the straight medical costs, Figure 8.1 can be presented, as below.

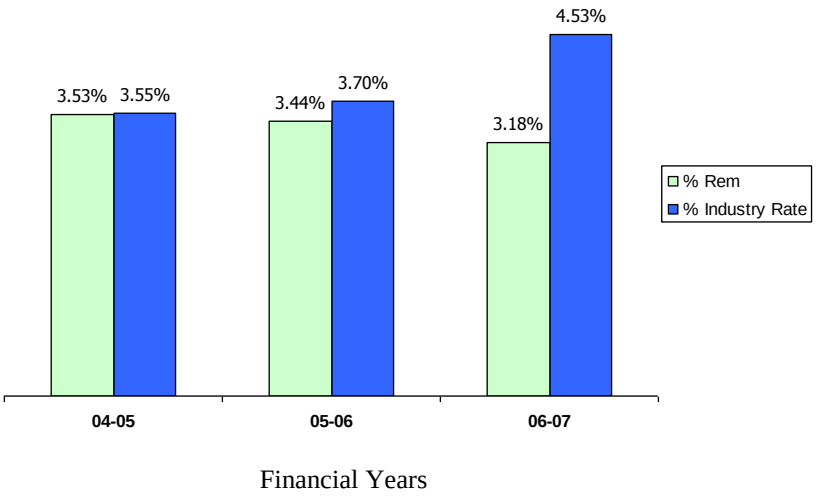


Figure 8.1: Workers compensation comparison as a Percentage of Remuneration compared to Industry Average for Visy Industries

Hence, compared to the overall industry performance, a significant improvement is identified. 1.35% (4.53-3.18) below the industry rate represents an approximate saving of $5.5 million annually for Visy, acknowledging the true cost is 3-4 times this. Finally, the increase in medical costs is largely due to change in legislation with state governments significantly increasing the estimates on the costs of injuries to recoup any future losses that may occur due to the cost of injuries the state will have to pay outside of the three premium company paid years.

The most significant improvement by far was in the proactive measures. This was a favourable result as these measures are those required legislatively with respect to safety, for example:

Risk assessments – this can be used as evidence of showing compliance to the risk based legislation that now exists in all Occupational Health and Safety Acts.

Workplace audits – this can be used as evidence of supervision and the maintenance of risk controls as specified in legislation.

Safety actions – although not a legal requirement this can be used to drive a proactive, safety improvement culture.

Toolbox talks – this can be used as evidence of training as required by OHS legislation.

Incident investigations – this is a legal requirement in terms of reporting and follow through.

However, more importantly, these are proactive measures for safety, and improve the workplace to help prevent injuries from occurring in the first place. The number of risk assessments, workplace audits, toolbox talks and incident investigations all increased by 303%, 394%, 411% and 229% respectively. The only area that decreased was safety actions, and this was due to a change in definition in the last year of the study, where safety actions were measured via safety improvement requests as opposed to all safety maintenance requests. This change was made as it was felt that a straight safety maintenance request would not accurately be a measure of safety improvement, which was the purpose of the measure. Nevertheless, the completion of 552 safety improvements per month was significant. These improvements indicate a significant increase in safety activity in the workplace. The next phase of the study was to determine whether the improvements identified in these measures translated into improvements in the actual perceptions of safety culture in the organisation.

8.6 Climate Survey II Findings

The second climate survey followed the same method and format as the first climate survey. The purpose was to provide a longitudinal assessment in order to strengthen the initial findings. However, there were changes in the organisation structure and personnel. Furthermore, specific company requirements of the second survey had changed slightly. The company had consolidated significantly and was implementing a strategy to remove divisional differences. A corporate vision named “One Visy” was to be established. This meant that overall company results were more important to the senior management team than the results from individual units or divisions. Also, there had been significant improvements in some areas as a result of

the first climate survey recommendations being implemented. Firstly, more investigation was being undertaken in terms of training and development of staff. Secondly, there were changes in insurance and injury management providers which required some minor changes to the instrument. That said, the intent and style of questions remained consistent across climate surveys and interviewees where possible.

The results were very positive in most aspects. There were significant improvements in the three years between climate survey I and II. The improvements were as follows:

- There were several noticeable improvements with respect to engagement in safety activities in the last 6 months up to the survey in 2008:
    - Safety discussed at team meetings was up to 100%, an increase of 16%. In other words, safety was discussed at every team meeting.
    - Risk assessments was 84%, an increase of 20%, there were a lot more risk assessments completed to the defined target for each location each month.
    - Safety inspections was 73%, an increase of 17%, a lot more of the defined number of safety inspections was completed for each month.
    - Incident investigations was 73%, an increase of 25%, meaning 73% of all incidents had a formal investigation completed.
    - Workcover claim reviews was 82%, an increase of 20%, hence 82% of all locations had a claim review each month.
- The perception that safety was a priority was 100% in agreement, a 2.5 fold increase since the first climate study was conducted.
- Safety responsiveness and follow through was 91%, with those strongly agreeing at 36%, up from 5% in the previous survey
- Those in strong agreement with the level of safety communication was 43%, up from 17% in the first climate survey.
- Personal commitment to safety was 84%, an increase of 24%
- Perceived commitment from plant management and employees in general was up from the previous survey to 81% and 84%, respectively

- Safety capability remained high at over 90% for all areas except chemical assessments which was a poor performer previously and remained so. This was identified as an opportunity for training in the future.

On a scale of 1 to 4, where 1 is strongly disagree and 4 is strongly agree, the mean result comparing 2008 to 2005 showed an:

- Improvement in safety communication from 2.98 to 3.13
- Improvement in responsibility for safety from 2.95 to 3.07
- Improvement in safety training perceptions from 2.57 to 2.80

There was not a statistically significant increase in safety commitment, it was high to start with and remained high according to the results presented in Chapter 7.

Statistically, there were significant improvements based on a two-tailed t-test (using a 95% confidence interval) for mean values, as follows (again where 1 is strongly disagree and 4 is strongly agree):

1) Improvement in overall safety climate from 2.77 to 3.23
2) Improvement in perceptions of safety management from 2.86 to 3.24
3) There were statistical significant improvements in the engagement of six out of the nine safety activities (see chapter 7 section 7.3.2).

A number of areas were identified as requiring further improvement:

- There were still 48% of respondents who disagreed at the level of safety standards achieved in the company; this may also be due to the greater awareness and knowledge of best practice and standards developed over the three years of the study.
- Safety training had improved, but 27% of the respondents believed it could improve further
- Disappointingly, the perceived level of safety commitment by senior management had dropped slightly; this may have been due to significant structural changes in the company

- Engagement in safety training had improved, but was still low at only 57% for the last 6 months up to the second climate survey, again this may be due to the significant amount of change in the company that had taken place during 2008.

The following recommendations were made to the organisation following the assessment of the second safety climate survey:

Safety Leadership - Leadership behaviours and commitment could improve further through the management of safety actions and Key Performance Indicators for the most senior management.

Training - Minimum safety skills for each position of responsibility needed to be established followed by the development of a safety training plan targeted at the particular knowledge requirements.

Responsibility and Accountability - An audit of safety responsibilities and requirements needed to be undertaken and incorporated in all position descriptions.

Centralized functions - Safety functions analysis should be centralized to avoid duplication of resources.

Budget restraints - Corporate safety risk assessment should be included in the budget setting processes so to provide for an appropriate resource allocation.

Behaviour-based safety - Standards of best practice should be set across the organisation, and include programs such as behaviour-based safety.

In summary, the results of the second safety climate survey were very positive and highlighted a measurable improvement in performance. Statistically, there was a significant improvement between 2005 and 2008, and this lends support to the main research question, that the application of knowledge management principles to safety can improve safety performance.

8.7 Synthesis of Research Findings

Safety is a very complex area and there have been many approaches by governments and organisations to improve safety performance. Common approaches have included: legislation and associated prosecution, procedures and manuals, Australian standards and codes of practice, training, leadership, technology and even behaviour-based safety. However, despite all these approaches and techniques, there are significant injuries, hundreds of people dying

every year, thousands more being permanently injured, and many more requiring medical treatment and rehabilitation due to a work related injury.

Hence, the current approach can be summarized in the following topics:

- Legislation and Prosecution
- Procedures and documentation
- Training
- Safety Leadership
- Technology and
- Behaviour based safety

These will now be discussed, including their benefits and short falls.

Legislation and prosecution is often a focus of many organisations and is supported by the documentation on responsibilities for directors and those with significant accountability and access to resources. However, just focusing on legislation is a flawed strategy as it does not directly ensure those on the shop-floor work safely all day, every day, and is often a reactive approach after a serious incident. This is supported by the work of Hopkins (2001).

Development and adoption of appropriate *procedures and documentation* is another common approach. That is procedures are written and all staff are held individually accountable. This is a common approach in organisations that produce volumes of procedures and manuals on everything from how to talk to each other in a meeting, through to complex control systems for machine operation. However, procedures forever need updating and revising, they are virtually out-dated when completed, and then there is training and follow through to ensure everyone knows what is contained in them (Douglas, 2008). Despite this significant effort, workplaces with large amounts of procedures and paperwork still have serious accidents (Ellis, 2004; Kumar, 2011).

Training is another very common approach to safety improvement. That is, training on everything from how to use Personal Protective Equipment, how to audit, how to raise a safety issue, to how to run a meeting. Training can be very costly and time consuming both on and off-the-job. However, training does not necessarily ensure that staff remembers the knowledge and how to apply it. In reality the gap between what is taught and used in practice often leads

to serious injury (Edmondson & Roloff, 2009). The complexity of training skills requires constant updating, in a similar manner to that for the procedures and documentation.

Safety leadership is a very common answer to improving safety. The role of leadership is to stress why safety is important to everyone, and to demonstrate to staff how they should go about it. The assumption is that everyone will then work safer and no accidents will occur. However, such a strong approach at the safety leadership level does not necessarily correct a poor workplace or team environment (Berger, 2006).

Another approach is to use *technology* to provide the answer, via databases to record safety information, or innovative engineering solutions (Choi, Lee & Yoo, 2010). Examples of these are black box recorders for fatigue in vehicles, proximity sensors for forklifts and pedestrians, risk management databases, and infrared machine guarding sensors. However, it is also argued that even the best machinery and technology in the world (assuming a company has the resources) will not eliminate all injuries, and often at times introduces unintended outcomes such as psychological stress. In addition, when the technology fails, an even more serious accident may occur (Reason, 2000).

Finally, another approach is *behaviour-based safety*. That is, a very innovative technique used in many progressive organisations is to task managers to be out on the shop-floor observing good and bad behaviours and giving feedback. However, serious injuries still occur even in such progressive companies where safety is their top priority.

This study does not argue that these approaches do not improve safety performance, indeed many can produce significant improvements. However, this study does argue and demonstrate through evidence that it is the knowledge management framework and implementation that should be the overall driving force of a continuous improvement system. The most positive outcome from all of these approaches is the physical activities and actions that take place in the risk environment. The workplace improvements carried out in the interest of safety were confirmed statistically through employee engagement in safety activities in this study. They all form part of a knowledge transfer approach to safety. Knowledge management should be a part of the strategic implementation of a range of safety techniques as a part of any safety program.

In terms of safety knowledge management, the emphasis is on the transfer of information into action. First, to identify the characteristics of the knowledge as identified by Probst et al. (2002), then choosing a transfer type as identified by Dixon (2000 and 2012), and following it up with performance measurement and monitoring. Hence, this study shows that a more

holistic approach to safety program implementation and improvement should use a knowledge management framework as a foundation.

8.8 Re-Examination of the Framework

Following the Practical Applications and the Second Climate Survey the initial framework presented in Chapter 4 was re-examined and altered accordingly. Firstly, the model needed to include how the data and information is converted to knowledge and used for safety. To do this the knowledge characteristics from the information needed to be developed. Then one can choose the appropriate knowledge transfer mechanism to apply. This can then be used to choose the appropriate safety knowledge application. Finally, the action research cycle based on continuous improvement needs to be more prominent, hence this cycle was added to show the ongoing development of the framework. The final safety knowledge framework is shown in Figure 8.2.

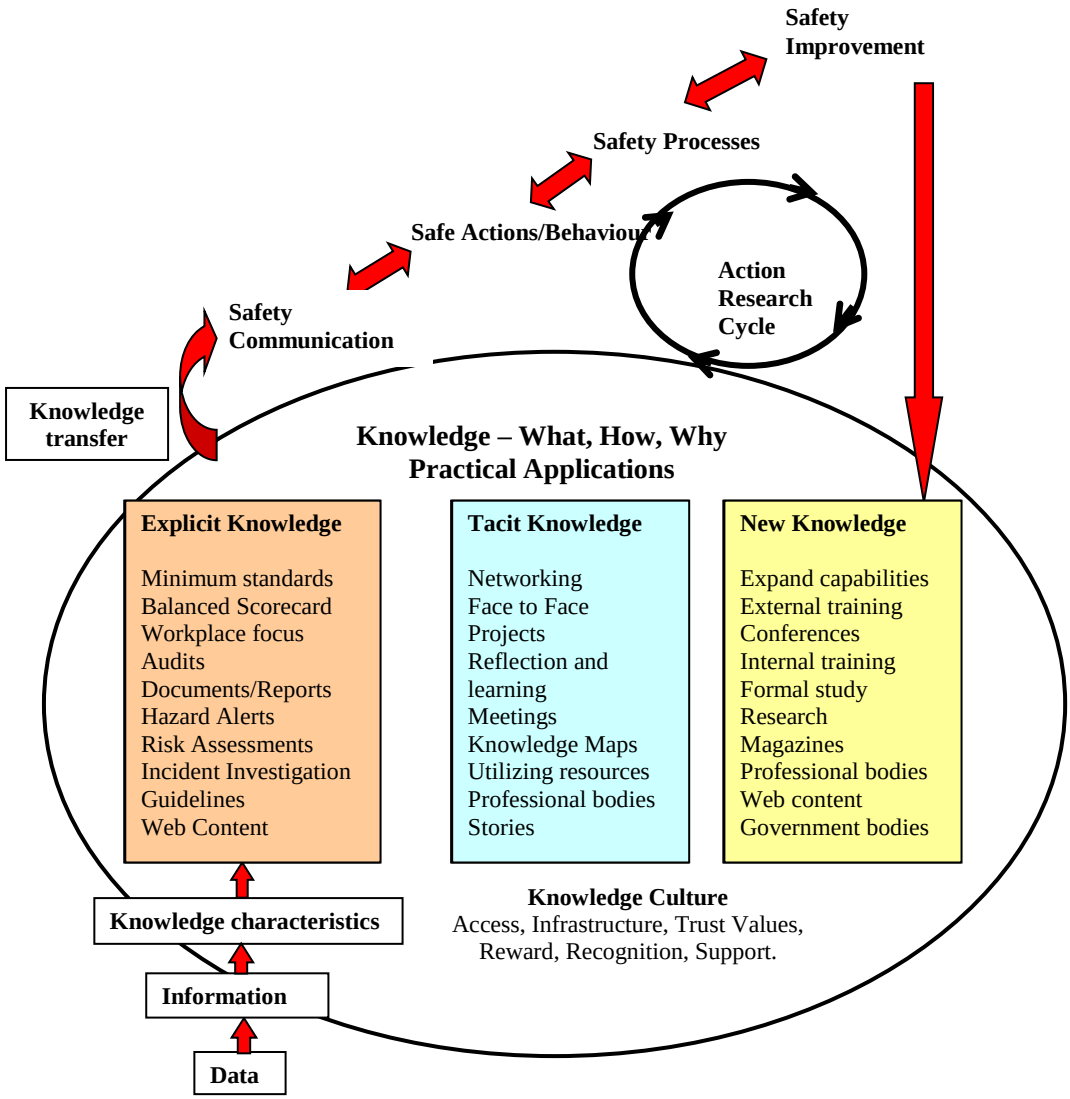


Figure 8.2: Safety Knowledge Framework

8.9 Summary of Chapter 8

This chapter discussed the findings of the research program aimed at improving safety performance. The results positively support the research question that the application of knowledge management principles to safety can improve safety performance. There was a discussion of the current state of performance of OHS in Australia to set the scene for an in-depth discussion of this research. Section 8.2 discussed the exploratory phase and how it established the basis for a safety knowledge management framework. Section 8.3 discussed the findings of the first climate survey and its practical applications. Following this, there was a discussion on the results of the second climate survey findings. Section 8.7 presented a concluding discussion of this research and how this research is different or complementary to other approaches to improving OHS performance. Finally, in Section 8.8 the safety knowledge framework was revised. The next chapter presents the major findings and conclusions of this research.

CHAPTER 9

CONCLUSION

This chapter presents the major findings of the study and discusses the contribution the study makes to the safety management field in terms of theoretical, methodical and practical contributions. Section 9.1 summarises the research questions and section 9.2 briefly states the method used. Section 9.3 covers the major findings based on theory and the practical applications relating to safety and knowledge management over the three years of the study. Section 9.4 then explains how the study contributes to the theoretical field of study of safety management. Section 9.5 discusses the methodical contribution that the study makes to the field. Section 9.6 covers the final contribution of the study in terms of practical implications and contribution to safety management which is very much a practical application of the research. The final two sections highlight the limitations of the study and suggestions for future research in the field of safety management and how knowledge management can be applied to this discipline.

9.1 Purpose of the research

The purpose of this research was to determine if the application of knowledge management principles is positively related to the improvement of Occupational Health and Safety in a large Australian organisation. The research also addressed a few sub-elements of this, how to measure safety improvement, knowledge management and principles with respect to safety, differences to existing approaches. The research also provided a summary of the literature in the areas of knowledge management and safety management and developed a framework that could be applied in other organisations.

9.2 Research Method

The research was carried out in a large multifaceted organisation over three years from 2005-2008. It involved two major climate studies (see Chapter 5 and 7) and 16 practical applications

(See Chapter 6). It also involved a performance measurement of 14 measures, measured both monthly and annually.

9.3 Summary of findings and research question

A key finding in this study is that safety performance in Australia can still improve significantly. The risk of injury is 1 in 12 and serious injury 1 in 200, that is, 2,700 work-related deaths and 650,000 injuries annually. The cost to Australian economy is in excess of $57.5 billion annually or 5.9% GDP (Kumar 2011). And even more so, in the major case study organisation (Visy) the safety performance in the company was very poor at the beginning of the study, with a 1 in 3 chance of being injured. There was a significant cost burden associated with this, not to mention the cost to families and friends affected by those injured, and also the legal exposure of senior managers and directors of the company.

An exploratory analysis of the two case studies in a large manufacturing company (see Chapter 4) in Australia revealed the following characteristics to improve safety in an organisation using a learning organisation, and later knowledge management concepts being:

1. Expand the knowledge of the workers of the organisation.
2. Utilising knowledge resources internal and external to the organisation.
3. Create entrepreneurial activity amongst workers in the organisation.
4. Gain enthusiasm from employees and drive support for new initiatives.
5. Time for reflection and learning as part of regular work.
6. Set up horizontal teams in the organisation to solve problems.
7. Allow risk taking for new ideas within a controlled environment.
8. Develop problem solving skills and expertise in the workforce.
9. Focus on value adding activities but consider the ‘big picture’.
10. Provide/establish recognition and reward systems.

From this exploration and through the study of safety management and knowledge management frameworks, a safety knowledge framework was developed, and was subsequently refined to form a safety knowledge framework which can be applied to safety management (see Figure 8.2).

In order to establish the benchmark for the major case study organisation a comprehensive climate survey was first conducted in 2005 (Climate Survey I in Chapter 5). This involved conducting telephone interviews of 118 managers and safety contacts/professionals. Climate Survey I collected both quantitative and qualitative data through phone recordings of interviews. The data and information included major themes of Safety Climate, Safety Commitment, Safety Capability and Engagement in Safety Activities. The key findings were:

- There was a lack of resources in terms of personnel and systems and processes
- There was insufficient skills and knowledge training in safety
- There was a lack of safety expertise within the company
- There was a need for better safety communication
- There needed to be better safety measures beyond those of injuries
- There was a lack of knowledge exchange between safety personnel in the company
- There needed to be more commitment and deliberate action on safety.

Overall, the perception of the Visy' safety climate was poor in 2005 and there was a need for significant improvement. Hence, the establishment of a series of practical applications to apply knowledge management principles to safety management using an action research approach (See Chapter 6).

The practical applications first involved identifying the data and information that was current in the company and how that could be converted into knowledge. From this knowledge base, it was then necessary to establish knowledge transfer mechanisms. These were then used for a serious of practical applications in an action research study of a companywide safety improvement strategy. The practical applications included: Legislation and Regulation; Safety Leadership and Culture; Safety Strategy and Action Plans; Risk Analysis and Hierarchy; Safety Systems; Employee Consultation; Behaviour Based Safety; Work Environment; Injury Notification; Incident/Accident Investigation; Safety Training; Auditing and Compliance; Measurement and Statistics; Injury Management; Health and Wellbeing and Off-the-job Health and Safety.

In the implementation of these practical applications using knowledge management principles, it was found that safety performance could be improved.

To further test the validity of the main research question a balanced scorecard approach was utilised (Juglaret et al., 2011). The safety performance measures monitored and their improvement were (See Section 8.5):

1. Lost time injury rate down 40%.
2. Medically treated injury rate down 61%.
3. All injury frequency rate up 46%, includes minor injuries.
4. Severity rate down 46%.
5. Employees on return to work plans up 31%.
6. Employees not at work due to work injury down 50%.
7. On time reporting of injuries up 15%.
8. Workers compensation costs per employee unfavourably up 12%, due to legislative change.
9. Workers compensation medical costs unfavourably up 40% due to legislative change.
10. Number of risk assessments completed up 303%.
11. Number of workplace audits completed up 394%.
12. Number of safety actions completed unfavourably down 60%, due to definition change.
13. Number of toolbox talks completed up 411%.
14. Number of incident investigations completed up 229%.

The improvement in these measures was significant and demonstrated that the practical applications were successful in driving safety performance using knowledge management principles and an appropriate framework. There was a perceived adverse result in Workers Compensation, however compared to the industry as a whole, this represents a 30% improvement, and legislative changes caused the increase even though relative claims and costs went down significantly during the three years of the study between the years of 2005 and 2008. This represented a saving of directly $5.5 million for the organisation annually and indirectly 3-4 times that.

However, to add even more evidence and weight to the main research question, a second climate survey was conducted to assess the change in perceptions with respect to safety over time (See Chapter 7). The second climate survey followed a similar approach to the first with very similar qualitative and quantitative data collected. The key findings from the second survey in comparison with the first were:

Improvements in engagement in safety activities in last 6 months (all six of these were also statistically significant at the 95% confidence level):

- Safety discussed at team meetings increased by 16% to 100%
- Risk assessments up by 20% to 84%
- Safety inspection up by 17% to 73%
- Incident investigations up by 25% to 73%
- Involvement in workcover claim review up by 20% to 82%

Other positive improvements:

- Safety was a priority up by 40% to 100% in agreement
- Personal commitment to safety up by 16% to 84%
- Personal commitment by plant management and employees up to 81% and 84%.

Areas identified for further improvement

- 48% agreeing that the level of safety standards could improve (this may be due to increased knowledge and understand of safety standards.)
- 27% believed safety training could still improve
- Safety commitment of senior management dropped slightly (could be due to recent structural changes)
- Engagement in safety training up to 57% could improve further.

The findings thus lend support to accept the main research question that the application of knowledge management principles to safety management can improve safety performance.

9.4 Theoretical contribution

The study of the literature found that many approaches to safety were common in terms of approach, that is, systems and questionnaires. For systems, much of the theory involved identifying a range of topics for safety based on a standard. Such as references and papers on the British Standard BS 18004:2008; BIP 3094:2013 and Australian Standard for safety AS4801 or the NOHSC guidelines for safety management (Leveson, 2011; Weinstein, 1997; Roughton, 1993). There were many books and examples of this approach listing a range of safety aspects or topics and then providing examples of procedures and forms which can be used. The issue with this approach is that there is an inadequate link between the theory and practice. Safety management is all about theory applied in practice, as provided by Erickson (1996:76):

"In order to achieve an appropriately balanced conceptual and practical treatment of the many aspects of contemporary Occupational Health and Safety, …, a broad overview of the field, …, implementation of various types of programs for ensuring corporate compliance with selected health and safety regulation, …, and specialist issues that extent well beyond the jurisdictional interests of any individual regulation and typically require a comprehensive appreciation, …, developing issues in science, technology and business management."

This research supports the view provided by Erickson, but even in his work there is a lack of follow through to practice. In other words, how to implement each of these topics to ensure they work in practice to improve safety is missing. Another common approach found in the theory is the exclusive use of surveys or questionnaires that are carried out for safety as a subset of management research. This can produce some good evidence such as in safety climate survey II (chapter 7). But they do often lack good links to theory and even more so to statistical rigor.

Hence this study attempts to bridge some of the gaps that exist in current theory with practice. By providing the scope and content of the field of safety research and then to measure performance and implement it in practice over a longitudinal study.

In the literature there are very few good models of safety management apart from the continuous improvement cycle. One reason for this may be due to the lack of research across other management disciplines and approaches. Hence, to improve this aspect of the theory this study looks to the field of knowledge management that has many models and approaches (chapter 4.2.2) which can then be applied to safety management.

Thus the major contribution this study makes to the safety management field is that knowledge management can be applied to safety management within a framework. In demonstrating this, the study also shows how knowledge management principles and concepts can be applied to safety management. The framework which takes information and data that exists in an organisation and converts it into knowledge using the approach by Probst et. Al (2002), then takes that knowledge and determines the most appropriate transfer mechanism as identified by Dixon (2000 and 2012). Then through real application these are implemented in practice

through core safety principles. Finally, the cyclical nature of the model introduces the continuous improvement aspect as shown in Figure 8.2 at the end of the last chapter.

9.5 Methodical contribution

The main methodical contribution this study makes is to support the research methods of triangulation as identified by Jick (1979) and the advantages of a longitudinal study by Stebbins (1992). The methodical triangulation consisted of qualitative (Myers, 2013), quantitative and case study information.

The quantitative data included comprehensive surveys of 160 people over the course of the study, injury performance measures, injury management performance measures and leading or proactive performance measures. The study showed that it is necessary to critically analyse the data and information and to not take the values at face value, as safety is a complex field, which can involve a lot of complex inputs and influences. The measures also need to be studied under strict academic and statistical rigor.

The qualitative data consisted of 160 interviews that were recorded and transcribed. There were issues with transcription that future research needs to recognise in the method of safety research. The amount of data which was collected, transcribed, and analysed was extensive. Each interview took about 15 minutes, and overall produced over 800 pages of transcription that had to be analysed. Hence, those using such a method need to be aware of this issue. However, the deductive approach for analysing the data as suggested by Ryan and Bernard (2010) was found to be appropriate and of value in safety research. Also, case study research did help to identify core themes or approaches as an exploration technique as identified by Ryan and Bernard (2010). As also identified by Engestrom (1987), this was appropriate due to being a relatively new area of research. The case study methodology did have its limitations where the level of depth limited the scope, for example, it would be very hard to achieve the level of depth in the study across several organisations with one researcher (an opportunity for future research). However, the case study approach was valuable in gaining more insights into topics, and was critical in developing value added recommendations for the company that could not be obtained from just quantitative data.

With respect to the longitudinal study, this approach did add a lot more rigor and quality to the research. However, it did still have some of the common issues with such an approach

(Stebbins 1992), in that there were many changes in the organisation over the time including major structural ones which would have had an effect on the final results but not the overall conclusions and findings. Also, it was not possible to follow up with exactly the same respondents from climate survey I to climate survey II as many had changed positions or left the company. 60% of the participants participated in both surveys. Finally there was also the issue of the requirements of the organisation slightly changed from the first survey. That is recommendations originally provided resulted in change, so it was not possible to use exactly the same questions, however, the major themes were still consistent and good comparisons were made.

This study showed that a comparison between qualitative and quantitative data could produce common results when it comes to safety performance improvement. The research shows that case study research should be used more often for safety research than traditional questionnaires, particularly to explore new concepts and ideas. It showed that such an approach can add more value than just questionnaires alone, as questionnaires do not explore the complete depth of the topic.

9.6 Practical contribution

By far the most significant contribution this study makes is in the practical application of safety management using knowledge management principles. As noted several times already, safety is very much dependant on practical application, and safety research is only as valuable as the improvement it creates in a company's financial, legal and moral obligations through reducing injuries in a workplace. The study provides evidence of how to improve the safety performance of an organisation towards best practice. The approach taken, can be summarized in the process steps identified in Figure 9.1, and these can be applied in any organisation to improve their safety performance.

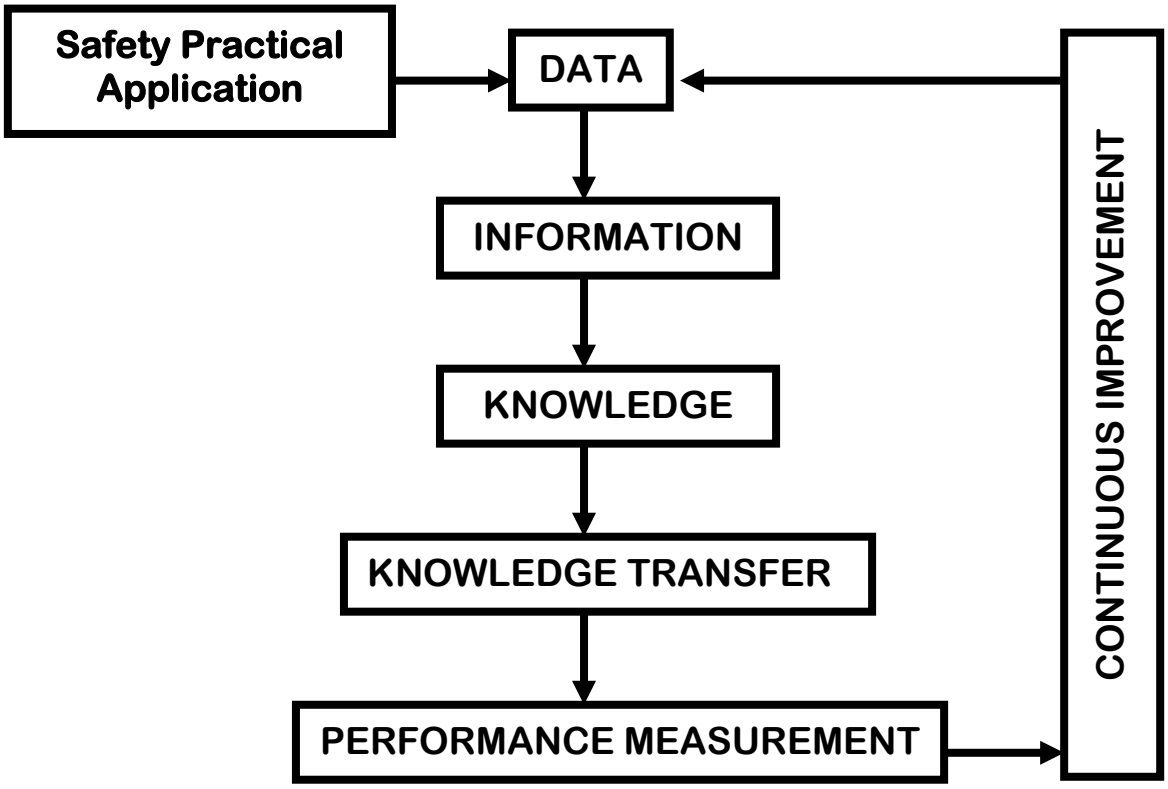


Figure 9.1: Safety Knowledge Implementation Process

The overall safety knowledge framework (Presented in Figure 8.2) is the method that can be used to graphically represent these steps for presentation in practice.

Further to this, this study helps safety practitioners and organisations alike to develop safety performance and monitoring that can lead to safety best practice. These included a range of performance measures, some of which are known by safety practitioners such as lost time injuries and others that have been developed, such as a severity rate. More importantly, the performance measures show how legal requirements of risk management, procedures, training and supervision can be measured and implemented in practice.

The study also shows how workers compensation can be a valuable addition to safety when integrated appropriately and even argues that injury management should be key knowledge to be developed and known by all safety professionals in the field.

The study also provides many practical examples and experiences in the application of core safety principles, e.g. what issues can be encountered, and ways of overcoming them. The practical applications draw on many years of experience by the researcher and work developed by many other safety professionals in practice. These applications can be used by practitioners to help guide them as they go through their own journeys to improve safety performance. They are by no means exhaustive as each topic alone could be a study in itself, but rather they develop insights and ideas that could be adopted or modified for a particular organisation and circumstance.

This study also critically analyses common approaches for improving safety which have a sole emphasis on:

- Acts, Regulations and legislation.
- Procedures and Standards
- Training and competency
- Safety leadership and management
- Technology and databases
- Behaviour-based safety.

Although these are all recognised to make a contribution to safety improvement, it is the approach taken and how they are implemented in practice which is more important. Through this study, it was shown that an overarching approach of knowledge management can be used to help better drive improvement than any individual emphasis.

The application of knowledge management principles presented in this research has implications for employees, specialists, management, industry and government organisations involved in safety. For employees, the study shows the need for individuals to maintain and develop their knowledge whilst in the workplace. For OHS professionals, it shows that knowledge management should be the driving force of safety improvement programs and this can be done through the safety knowledge framework. Specialists need to continually develop themselves and then be capable to transfer that knowledge into the workplace in a practical sense. Specialists can also use the practical applications and performance measures as a means of improving the safety in their workplaces. Specialists also need to understand and learn how to convince management and organisations to improve safety using knowledge management in

a practical sense. Management needs to understand that knowledge management needs to be a part of their strategies and approaches to improving safety, they need to understand what knowledge management is with respect to safety and how to transfer it into action. Industry needs to be more open to using new ideas and concepts to improve performance and to concentrate on the process rather than the exact outcome of dollars or products. The implications for government organisations and enforcement agencies for OHS is to recognise that for substantial, sustained safety improvement, there needs to be a much greater emphasis on knowledge management and training, and not simply use of the law and associated legal processes for enforcement.

Finally, the research in itself also shows how the academic discipline of a major study can be integrated with a practical application and approach in practice, thus helping to bridge the gap that is perceived to exist between academia and practice, particularly in an area of safety management.

9.7 Limitations of the research

It is important to acknowledge the limitations of this research, and these are recognised as follows:

- Generalization of the results to other organisations should be done with caution, particularly when they are associated with industries not covered by the organisations studied in this research, e.g. safety in the medical industry.
- Generalization to other jurisdictions of safety which may have vastly different legislation and cultures towards safety, e.g. international comparisons. This is particularly the case with workers compensation, for example, in New Zealand where the Accident Compensation Corporation covers injuries at home or work, however the principles are the same with respect to safety.
- The case study organisation underwent major structural change during the course of this research program which may also have affected the results, but it is believed this is not to an extent to affect the major findings.
- The improvements made may also be due to other environmental factors such as injuries reduced due to the introduction of more automation or a new facility or indeed a significant change in the management of a particular area.

- The inductive and numerical analysis of the climate surveys is based on the perceptions of respondents.
- The researcher was involved intrinsically throughout the study including some interviews which may have affected outcomes but steps were taken to minimize this affect through the study (see chapter 3).

9.8 Future Research

The application of knowledge management to safety management is very rare in practice, more so in the literature, and a new concept in many ways. Hence, there is a lot more work that can be undertaken to strengthen this area, and as a result it is a great opportunity for future research to improve a most critical aspect of society, safety of people. The safety field is not well researched from a management perspective, there are few studies that stand up to academic and statistical rigor. This study has started to explore the area in more depth whilst maintaining a practical application and influence.

There is an opportunity for more research into specific knowledge management techniques and approaches such as data mining in safety management and research. There needs to be more work undertaken to bridge the gap in terminology and approaches between knowledge management and safety. For example, what is safety knowledge, and how is it translated and used in practice?

On a micro level, the organisation studied can be revisited in the future to assess the sustainability of the approach and examine the perceptions and improvements that follow on from the second climate survey recommendations.

Because of the level of depth and exploration of this study, there needs to be more research into how this approach and model would be applied to other industries and indeed trialled in other companies to see if similar benefits can be obtained. Also, the approach can be adopted and researched further for its application in government audit and compliance organisations that have a responsibility for driving safety improvement in companies, e.g. WorkSafe Victoria.

There is also a need to explore the practical applications in more depth to allow them to be more structured in their own right. This includes risk management, it was only briefly

incorporated in this study, but there needs to be more research and analysis of risk management in safety management practice. The performance measures can be analysed further to ensure common definition and approach that can then be used to adopt broader safety performance measures for industries beyond the existing injury statistics. This should include the creation of more national databases and records of other safety information and data for further analysis and improvement. Finally, there is an opportunity to examine other management systems and approaches and how they would integrate into a common approach using knowledge management. These areas may include quality management and environment management.

GLOSSARY OF TERMS

A

Accident Iceberg – A safety model which depicts the seen and hidden costs of safety in an incident.
AS – Australian Standard
Act – Legislation passed by government
Auditing – The systematic process of inquiry to a defined set of criteria or standard.
ACC – Accident Compensation Corporation (of New Zealand).
ASCC – Australian Safety & Compensation Council
AFG – Alex Frazer Group
Action Research – Action research is an iterative process involving researchers and practitioners acting together on a particular cycle of activities, including problem diagnosis, action intervention, and reflective learning.
ABS – Australian Bureau of Statistics

B

Behaviour Based Safety – A safety observation technique involving positive and negative feedback within the working environment.
BSI – British Standards Institute
Best Practice – A common term which describes the very best practice in the field.
BS – British Standard

C

CCH – Commerce Clearing House (publication agency of Australia)
CEO – Chief Executive Officer
CFR – Code of Federal Regulations (OSHA standards publisher for the USA)
Culture – the behaviours and beliefs characteristic of a particular social, ethnic, or work group
Capital – the wealth, whether in money or property, owned or employed in business by an individual, firm or corporation.
Climate – the prevailing attitudes, standards, or environmental conditions of a group, period, or place.
Code of Practice – Guidelines which are not legally binding produced by authorities to explain how to meet the legal regulations in practice.
Consultation – a meeting for deliberation, discussion, or decision.
Capex – Capital Expenditure

D

DBA – Doctorate of Business Administration for which this research aims to obtain.

Directors – Senior officers within a company

Data – Numbers and Figures in there raw form, not processed

E

EH&S – Environment, Health and Safety

Explicit Knowledge – The knowledge that can be described and written in text

EPA – Environmental Protection Authority

F

FATI – First Aid Treatment Injury – An injury that can be treated within the workplace by a qualified first aider.

FMEA – Failure Mode and Effect Analysis, a technique which determines the cause of a failure or incident by analysing a point of possible failure in a system based on probabilities.

G

H

Health and Wellbeing – soundness of body or mind; freedom from disease or ailment

Housekeeping – The process by which a workplace is kept clean and tidy

Hazard – The potential to cause injury or harm

HSSE – Health and Safety Senior Executive

HMSO – Her Majesty's Stationary Office

HSE – Health, Safety and Environment

HazOP – Hazard and Operability Study – A process by which the cause of a hazard is identified through a study of each step in the process.

I

Injury – The physical human condition as the result of an incident or accident.

Industry Commission – Department of the Australian Parliament concerned with employment matters.

Incident Investigation – The process of systematic enquiry to determine the causes of an incident.

Incident – An event that causes injury or loss both physical and material

ISO – International Standard Organisation

IT – Information Technology

Information – Data and words that have been processed into a useful format for analysis and learning

J

Jurisdiction – The scope or area for which a legal document applies

K

Knowledge Management – The processes and systems that control and maintain knowledge.

Knowledge Management Principles – The basic principles and techniques associated with knowledge management.

L

Legislation – a law or a body of laws enacted.

Longitudinal – pertaining to a research design or survey in which the same subjects are observed repeatedly over a period of time.

LTI – Lost Time Injury – An injury that results in one or more days off work.

LTIFR – Lost Time Injury Frequency Rate, The number of LTI's for every one million hours worked, as defined in the Australian Standard.

LOTO – Lock out/Tag out – a method for isolating power sources to a piece of equipment or machinery.

M

MTI – Medical Treatment Injury – An injury that requires the treatment of a medical professional.

MTIFR – Medical Treatment Injury Frequency Rate, the number of MTIs per million hours worked, as per the Australian Standard.

MSDS – Material Safety Data Sheet, a form from the manufacturer which describes all the safety precautions for a chemical; first aid treatment, storage requirements, composition, dangers and other relevant information to users.

Manual Handling - Manual handling is any activity involving the use of muscular force (or effort) to lift, move, push, pull, carry, hold or restrain any object, including a person or animal

N

NOHSC – National Occupational Health and Safety Commission of Australia.

NSCA – National Safety Council of Australia.

NTC – National Transport Commission of Australia.

NSW – New South Wales, state of Australia.

NOSI – National Online Statistics Interactive (Australian Safety and Compensation Council injury database)

Norms – a set of standards, models, or patterns that are followed

O

OHS – Occupational Health and Safety

OHS Policy – Occupational Health and Safety Policy which describes the company's commitment to safety and main aspects of this commitment.
Off-the-job – A term to describe activities and issues not associated with work or employment.
OSHA – Occupational, Safety and Health Administration, United States national safety body.

P
PA – Practical Application – For the purpose of this study a term to describe the implementation of a knowledge management principle to a safety area, in practice.
PPE – Personal Protective Equipment – Equipment that is used as a defence of harm to the human body, usually chemical, such as glasses, clothing or shoes.
Performance Management – the management of the execution or accomplishment of work, acts or feats.
PAL – Pilkington Australasia Limited.
PDCA – Plan, Do, Check, Act acronym for the continuous improvement cycle.
PIN – Prohibition Improvement Notice – A notice issued by the authority or safety representative with a legal implication specifying that there is a safety issue that needs to be fixed.

Q
Quality Management – A set of processes and systems designed to improve the performance of a product or service.

R
Regulations – A legal document which describes how a company is to meet the requirements of an Act includes penalties for non-compliance.
Risk – the hazard or chance of loss, or the degree of probability of such loss.
Risk Assessment – The process or system by which a risk is obtained and analysed for control and minimisation.
Reputex – An Australian organisation that evaluates a company's corporate responsibility.

S
Safety Management – The processes and systems that control and maintain safety.
Safety Management Principles – The basic principles and techniques associated with safety management.

Senior Officer – senior management position with authority and responsibility for safety
SafetyMAP – Safety Management Achievement Program (A system of elements developed by the Victorian government WorkSafe authority).
SMART – Acronym for objective setting goals stands for Specific, Measureable, Achievable, Results oriented and Time frame.

T
T-test – A statistical analysis of significance
Taylorism – A philosophy which follows the teachings of Fredrick Taylor associated with time and motion studies.
Triangulation – A process by which qualitative and quantitative research is used to test a research question.

U
US(A) – United States of America
UK – United Kingdom

V
Vic – Victoria, state of Australia
VisyROM – Visy Risk and Opportunity Management system, an online data entry and workflow system for recording and tracking progress of incidents.

W
Workcover – Workers compensation system in Australia.
WHO – World Health Organisation.
Workers Compensation – A government system which provides management, rehabilitation and financial support for injury workers.
WorkSafe – State safety authority of Victoria.

X

Y

Z

123
5C's – Safety model of Crisis, Control, Compliance, Commitment and Culture
5 Star – National Safety Council's safety management system which involves 60 safety element criterion broken down into five categories and is rated using a 'star' system.

5 Why's – Incident investigation technique where questioning to the void is used, it is believed to ask the question five times you will come to the root cause of most safety incidents.

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