Report to the

Coal Services Health and Safety Trust

Improving OHS Risk Management Strategies

in Coal Mines.

2007

Executive Summary

The effective management of risk is a key issue for all Australian mines. The recent trend towards performance based occupational health and safety legislation and standards has required mines to develop risk management programs and processes that identify, assess and control workplace hazards.

Poor risk management processes can cause fatalities, serious injuries and illness and yet in the Australian (and indeed the world) context while there is much information available regarding generic risk management techniques and practices, there is a significant gap in guidance material available for the management of risk and risk communications within Australian coal mines. It is also of note that what material is available is difficult to access, is fragmented and scattered.

Project to improve Risk Management in Australian Mines

This project including risk management manual and data base, has been funded by the Coal Services Health and Safety Trust. The project is designed to assist mining personnel by developing a more cohesive and sophisticated understanding of risk management and risk communications within the coal mining industry.

The manual and data base developed as part of this project provide generic guidance for establishing and implementing effective occupational health and safety risk management processes in mines. It demonstrates how to effectively identify, analyse, evaluate, treat, communicate and monitor risks.

The manual and data base is a reference guide for safety professionals, mine managers, health and safety representatives, operators, technical staff, line managers and staff when developing processes, systems and techniques for managing risks. The manual includes:

- A detailed overview of risk management processes in relation to coal mining;
- A best practice methodology, detailing aspects of hazard identification, risk assessment and control in coal mines;
- Comprehensive hazard listings for underground and open cut mining processes;
- Practical checklists for conducting and recording the results of risk assessments;
- A data base for the risk ranking of specific mining hazards; and
- Worked examples of specific hazards using identified methodologies

The contents are intended to provide a broad overview of contemporary risk management as it applies to coal mines. Organisations are expected to interpret this manual in the context of their own operations and develop specific approaches to manage their risks.

Methodology

The methodology undertaken for the project was the use of literature reviews, direct observation, structured interviews, questionnaires, and brain storming to identify and document examples of best practice risk management techniques within the Australian coal mining industry.

Key health and safety professionals from the coal mining industry were contacted and interviewed to determine a representative sample of best practice mines. The interviews with the key health and safety professionals provided important contextual information and assisted in the selection of the sites. Five sites were identified in the Hunter Valley in New South Wales and six in the Queensland Bowen Basin. The number of sites was divided between open cut operations and underground mines.

Interviews

Structured interviews were conducted on each site visited with key personnel including:

- Mine Managers;
- Site Health and Safety Managers;
- Technical staff;
- Mining operations staff; and
- In addition corporate Health, Safety and Environment (HSE) managers were also interviewed regarding health and safety management systems.

Cooperation form mining companies and mine site personnel was very high. Project highlights include:

- Site visits to both underground and open cut mines to observe and interview mine personnel regarding occupational health and safety and risk management;
- Development and administration of a questionnaire on risk management strategies developed, pilot tested and administered to a number of coal mines regarding on site occupational health and safety risk management techniques and practices;
- Direct observation of risk management techniques and practices on site including risk assessments at various coal mines;
- Risk assessment data base developed.

Results

Although this project was essentially a modest one, the level of co-operation from the industry has been very high. Both organisations and individuals have been particularly keen to participate particularly in the on site activities. From the many site visits, discussion groups, presentations and workshops it is possible to draw inferences on both the type and level of risk management activities being conducted across the sector.

All of the sites visited had extensive health and safety management systems, corporate HSE policies and risk management processes. All had internal quality control processes including internal OHS audits. However, some mines excelled in areas such as consultation and involvement of employees, implementation as opposed to paper systems and follow up and feedback to employees.

Risk Management - What is being done well?

In many areas the coal mining industry in Australia leads the way in the management of occupational health and safety risks. Some of the many positives identified during the project include:

- Risk assessment is part of the culture of the Australian coal mining industry;
- Risk assessments were observed being undertaken at various levels within organisations and across sites;
- Risk assessment processes and risks associated with major hazards are generally well documented within the Australian coal mining industry;
- Risk assessment methodologies used across the industry conform to either the methodology contained in the *Australian Standard for Risk (AS/NZS 4360:2004) or the methodology in AS/NZS 4801:2001;*
- Cooperation on safety between organisations is common. There are strong networks within the industry and health and safety information is shared routinely between many organisations;
- Staff interviewed like solving problems and being involved if they were heard and their advice was acted upon;
- Job Safety Analysis and personal risk assessments are used routinely on any sites to assess personal risks;
- Risks are regularly reviewed and audited;
- Major mining hazards are generally well understood by mining personnel;
- There is a 'focus on failure' in successful organisations. They are mindful of risks and injuries and are constantly reviewing controls and processes;
- While risk management can be an expensive process, resources are being committed by organisations;

- Corporate HSE systems provide minimum bench marks for the assessment and management of OHS risks which provide guidance and assistance to individual mine sites on how to manage risks;
- Employees are trained and involved in personal risk assessments such as job safety analysis;
- As an industry we are becoming more sophisticated in our approaches to the management of risk; and
- Cooperation on safety issues between mining organisations is more common than generally noted in other industries.

Risk Management - What can we improve?

Some of the major criticisms identified during the project regarding risk assessment activities include:

- They are used to justify decisions that have already been made. This severely reduces the credibility of the risk management process with employees and jeopardises future cooperation and risk management outcomes;
- Generic processes are used when there are site specific conditions that require and individual approach be taken. This is particularly true if risk assessments are taken from one site and used at another without careful review and input by the site employees;
- Risk assessments are being conducted on a push basis (fear of non compliance with legislation) rather than a pull basis where the organisation believes that it is good for business to manage safety properly and undertake risk assessments;
- Risk management programs are often poorly targeted, not evaluated or followed up to ensure that they have delivered value for money as well as safety improvement are wasteful.
- Assessments are conducted that only consider the risks associated with one activity. Cumulative or concurrent risks are generally not identified and assessed very well.
- Failure to identify all hazards associated within an activity. Due to rushing, poor planning or a lack of data.
- Managers do not always release staff to participate. Production pressures mean that employees who would have valuable information to contribute are not always involved;
- Managers and supervisors are not always involved in the risk assessment and so their valuable knowledge and experience is not always available.
- Production pressures sometimes mean that personnel are dragged out of a risk assessment.
- Chronic health issues (such as noise) are generally not as well recognised and assessed as acute safety issues;

- Poor planning and communication on site sometimes detracts from the risk assessment process. Staff are sometimes not given adequate warning that a risk assessment is being undertaken.

- Some staff did not feel they were adequately trained to undertake the risk assessment process;

- Many staff were not easily made aware of how a risk assessment links directly to their safety. This lead to feelings of disconnection and questioning of the process; and

- Poor communication. Some employees felt that not everyone is informed of the outcomes of a risk assessment and that feedback could be improved.

However, the major pitfall associated with current risk assessment practices identified during the literature review (and supported by discussions with mining staff) was that in some circumstances mine management did nothing with the results of a risk assessment.

Several persons interviewed indicated that although some good solutions to health and safety issues were raised by the employees, quite often nothing was done to implement the control or that excessive costs were used after the assessment to justify doing nothing and maintaining the status quo.

It is not enough to simply undertake a risk assessment. The organisation must be active and ensure that controls are implemented, that they are chased up, monitored and feedback is provided to those who have been involved in its assessment. Champions, not policemen, are needed to monitor and review risks and the implementation of controls.

Critical Factors

The commitment by senior management to health and safety and the management of risks was identified at almost all of the mines visited as the most critical factor in determining the success and uptake of the risk management program. If the senior management of the mine was committed to safety, did not tolerate safety violations and demonstrated commitment by applying time, people and resources to OHS risk management then the rest of the mine viewed it as important and this generally ensured a high level of commitment throughout the mine.

This level of commitment directly influenced the attitudes of middle management and staff within the mine. In mines where there is significant senior management support for OHS risk management activities production and technical staff were more likely to be available for and turn up to OHS risk management activities.

The way forward

Risk management in coal mining is a complex business. Regulatory regimes and society are becoming less tolerant of risk. There is an increased readiness within society for retribution and compensation. Therefore no organisation can afford to just pay lip service to the process of managing OHS risks.

It is not enough to simply undertake a risk assessment: you must follow up; you must ensure that controls are implemented; and that they are effective.

Risk management is not about paper it is about people and their safety. It relies on:

- Senior management commitment to demonstrate that safety is important and that risk management is a critical issue.
- Resources to make it happen. Risk assessments can be time consuming and expensive but the alternative is worse.
- Trained HSE personnel and champions not only to undertake the risk assessments but to drive the need to control risks effectively throughout the organisation.
- Champions not policemen to monitor and improve risk management
- Employees who understand the operations and are trained in risk management processes and assessments.
- Commitment by all of those involved in the process to achieving better risk management outcomes.
- Goodwill from mining staff to participate and recognition that risk management is about their own health and safety.
- Demonstrating that the time spent on risk management is an investment.
- Follow up, monitoring and review. Senior management must be involved and make it happen.

Conclusions

Overall the effective management of health and safety risks will have significant benefits for the community, organisations and individuals. If we as an industry can adopt and effectively implement best practice health and safety risk management principles, we can make the workplace safer, improve productivity, increase quality, remain competitive and raise the standard of living for all Australians.

The simple messages of commitment, organisational mindfulness, adequate resources and training need to be communicated to senior management, supervisors and health and safety professionals to ensure that risk management efforts are effective.

As middle management has a key role to play in the risk management process a way forward would be to develop additional strategies to assist middle management to drive health and safety improvement within the coal mines.

This could be in the form of training packages for middle managers targeted at understanding the five key priority areas nominated by the Coal Services Health and Safety Trust what can be done at an individual mine level to improve performance in these areas.

Supporting senior and middle management may be the best way of supporting lasting cultural change aimed at improving health and safety performance within the coal mining industry.

Acknowledgements

I would like to acknowledge the generous support of the Coal Services Health and Safety Trust so that this project could be undertaken. If health and safety is to be improved in coal mines then we must have a champion. The Health and Safety Trust is a safety champion for all coal mines and their employees.

I would like to specifically acknowledge Ken Cram for his assistance and guidance.

I would also like to thank the many mines, HSE staff, operators and managers that gave their time and allowed me access to their site, personnel and risk management processes. Safety should be shared and all of the participating mines should be congratulated for their efforts.

Contents

1. Introduction

The management of health and safety has been dominated by two major developments in the past twenty years: performance-based legislation with its risk management approach; and a more competitive and rapidly changing global environment. This is especially true for the coalmining industry. In many cases these two issues have determined the way in which the industry and individual organisations have managed their health and safety risk profiles.

Since the early 1980's most states have adopted performance based health and safety legislation. Coal mining legislation also follows this approach. This places a duty on employers and many others (suppliers, designers, occupiers, operators etc) to identify hazards, assess risks and eliminate or control risks to health and safety. Employers are also required to monitor the condition of the workplace and to consult their on OHS issues including the control of risk.

At the same time this legislative regime was introduced the business world has been exposed to a more competitive economic environment. These changes have forced organisations to move quickly and to make constant and ongoing changes to the work environment. New technologies, equipment, work processes, changes to staffing arrangements and unrelenting pressures to remain competitive have the potential to introduce new hazards and risks to the workplace. As a result of these pressures the management of health and safety risks and effective risk communication has become key issues for all Australian workplaces including mines.

Health and safety legislation requires mines to develop processes to identify, assess and control workplace hazards and implement risk management programs. The results and value of individual risk management programs is currently being debated within the safety industry.

The issue has been widely discussed in depth in the *Safety Institute's Journal (Safety in Australia, vol, no 24)* and by many regulatory agencies. The overwhelming view of both safety professionals and industry regulators is that the current risk management methodologies and processes were of significantly varying quality and generally thought to be poor and inadequate to effectively manage the risks that industry faces.

Poor risk assessment and management processes have the potential to cause fatalities, serious injuries and illness and yet in the Australian (and indeed the world) context while there is much information available regarding generic risk management techniques and practices there is a significant gap in guidance material that is available for the management risk and risk communications within Australian coal mines. It is also of note that what material is available is difficult to access, is fragmented and scattered.

What is required is cooperation and sharing of risk management strategies and controls as well as the development of minimum bench marks for risk management activities as well as a commitment to the continual improvement of risk management activities within the industry.

2. Research Proposal

The research proposal is:

"The identification and documentation of appropriate techniques and strategies to improve risk management and risk communication processes within Australian coal mines."

This project was designed to assist in developing a more cohesive and sophisticated understanding of risk management and risk communications within the coal mining industry. Specifically the outcome of the project was a risk management manual that contains guidelines, strategies and tools designed for improving risk management and communications processes within the Australian coal mining industry.

The purpose of the risk management manual and data base is to provide practical assistance to mines, managers, employees and other stakeholders on ways to improve the management of occupational health and safety risks within the Australian coal mining.

The risk management improvement project has worked collaboratively with the coal mining industry and has drawn upon its collective knowledge to develop practical solutions to OHS risk management issues. The risk management package will extend the understanding of risk management and communications within the coal mining industry.

3. Background

The Health and Safety Executive (1992, p 13) states that "The only effective approach to injury, ill health and loss prevention is one based on the systematic identification and control of risk".

Today, this is true more than ever; managing risk has become a fundamental business principle for the mining industry. In a volatile and fast changing global economy organisations are using risk management to assess alternative business opportunities, reduce uncertainty by identifying unusual risks, consider marginal projects, conduct pre-feasibility appraisals of projects and assess exit strategies for projects nearing the end of their life (Broken Hill Proprietary Company Ltd (1996).

Risk management is also used to provide a degree of protection for directors and corporate executives in the event of adverse outcomes (Standards Australia. 2004). Risk management principles are also applied by organisations to control a wide variety of sources of risk including:

- Commercial and Legal relationships;
- Economic Circumstances;
- Human Behaviour;
- Natural Events;
- Political Circumstances;
- Technology and Technical Issues;
- Management Activities; and
- Individual Activities.

Source (*Standards Australia. 2004. AS/NZS 4360:2004: Risk Management*)

Relevant occupational health and safety legislation and standards also specifically require the application of risk management processes to identify, assess and control workplace hazards (*Standards Australia. 2004. AS/NZS 4360:2004: Risk Management*).

In the Australian mining context, poor risk management processes and outcomes have a significant impact not only on injured workers and their families but also on the economy as a whole. This impact is undermining Australia's economic performance, thereby reducing living standards.

The Australian Safety and Compensation Council (2006) shows that the total number of compensated claims made in Australia, resulting in one week or more absence from work was 139,070 in 2003/04 . This is a total of 695,350 days lost due to workplace injuries. This is an underestimate of the total time lost as absences of less that one week are not recorded. This compares unfavourably to the number and amount of time lost due to industrial disputes for the year ended December 2004 where there were 379,800 working days lost due to industrial disputes (Australian Bureau of Statistics, 2007).

The Australian Safety and Compensation Council (2006) shows that there were 189 compensated work-related fatality claims in 2003/04 spread across all sectors. The mining industry has the highest Fatality Incidence Rate for any sector (claims per 100,000 employees) at 5. This is more than double the national average at 2.3 fatalities per 100,000 employees. (Australian Safety and Compensation Council, 2006)

The median time lost from work by employees on compensated claims in the mining sector was 2.8 weeks. This compares with construction sector at 3.0 weeks and manufacturing at 2.2 weeks (Australian Safety and Compensation Council, 2006). The most common type of injury was sprains and strains accounting for over half (51%) of all claims.

The most common causes of compensated injury and disease in the mining sector were:

- Body stressing (muscular stress due to manual handling or repetitive movement) which accounted for 34% of all claims;
- Being hit by moving objects which accounted for 19% of all claims; and
- Falls, trips and slips of a person which accounted for 21% of all claims.

These three causes for compensated injury and disease in the mining sector account for 74% of all compensated injury and disease in the mining sector.

The incidence of compensated claims in the mining sector for 2003/04 was 24 claims per 1,000 employees or 6 claims per day. This is well above the national average of 16 claims per 1,000 employees (Australian Safety and Compensation Council, 2006).

Previously the National Occupational Health and Safety Commission (1995) has estimated that work-related injury and disease costs business, workers and the community more that $20 billion a year. The Industry Commission (1995) report into Work Health and Safety further estimated that the average cost of a work-related injury or disease to be approximately $27,000. The distribution of the burden of this cost varies between employers, individuals and the community (Industry Commission into Work Health and Safety 1995):

- Employers bear about 35 per cent ($7 billion) - costs include workers' compensation, loss of productivity, and overtime;
- Individuals bear about 35 per cent ($7 billion) - costs include lost income, pain and suffering, loss of future earnings, medical costs and travel costs; and
- The community bears about 30 per cent ($6 billion) - costs include social welfare payments, medical and heath costs, and loss of human capital.

The Industry Commission into Work Health and Safety estimates that a 10 percent reduction in workplace injury and disease would see our national income (GDP) increase by approximately $425m. Of particular concern is the impact of such costs on the overall profitability of an organisation.

Although the total cost of incidents within an organisation may be relatively small, it can amount to a percentage of the annual running costs, and represents a direct drain on profits.

The table below illustrates the turnover necessary to cover these incident costs.

Table 1 Accident costs and profit margin

Accident Costs	If your organisation profit margin is:		
$	1%	3%	5%
1,000	100,000	33,000	20,000
10,000	1,000,000	330,000	200,000
100,000	10,000,000	3,300,000	2,000,000

Coal Mining Sector Health and Safety Performance

The high cost of health and safety incidents and compensation is illustrated by comparison OHS data from the two major coal mining states.

Queensland

In the Queensland coal mining industry a comparison between the years 2004 /05 and 2005 /06 for both underground and open cut coal mines does not indicate any significant improvement in any of the major OHS indices including the number of injuries, number of high potential incidents reported, number of disabling injuries and injuries per tonne (Department of Mines and Energy, 2006). Mine personnel are continuing to be injured and the number of high potential incidents continues to grow (see Appendix One).

The total number of workers compensation claims in the Queensland coal mining sector for 2005/06 was 782. This compares to only 207 lost time injuries. Compensation payments for the coal mining sector in Queensland totalled $6,031,624. Therefore there were 585 compensable injuries that did not incur lost time in the same period. These figures seem to indicate that the sector may well have improved its management of injury statistics and return to work processes but not necessarily risk exposures or accident severity rates.

New South Wales

Health and safety data for the New South Wales coal mines sector is more fragmented and difficult to access than that of the Queensland mining industry. Terminology and reporting standards vary between the states and reliable overall comparisons between the states health and safety statistics is difficult to achieve.

Whilst it is difficult to conclusively determine that the occupational health and safety performance of the coal mining sector in New South Wales is improving some key performance indicators such as Lost Time Injury Frequency Rate are showing some improvement (over the same period).

Compensation payments for the New South Wales coal mining sector (*Industry Performance Measures, Quarterly Report 2005, New South Wales Department of Primary Industry*) detail the number and cost of claims paid. In 20004 / 05 there were 4,093 compensation claims for a total of $72,579,826 at an average claim cost of $17,733 (see Appendix One).

Whilst there has been some improvement in the safety statistics of the coal mining sector in recent years some measure have remained static and other have gone backwards. Compensation costs are still extremely high and given the number of investigations and enforcement actions in New South Wales (494 investigations and 394 enforcement actions – all mines) many mines are still grappling with effectively managing health and safety risks (NSW Department of Primary industries, 2005).

As the economy that mines operate in has become more volatile, faster moving and increasingly sophisticated the type and nature of risks that coal mines face have become very different from the past.

The management of health and safety risks in a fast moving and increasingly complex operating environment is a key issue for coal mines. The mining industry is turning increasingly to complex technical systems to increase productivity and lower costs. These come with many benefits but also many risks.

This research project is designed to assist the coal mining industry to better manage risk management processes. The aim of the study is not to observe and record explicit changing levels of risk or incident trends. Rather, it is to identify and collate best practice methodologies of risk management to improve the manner in risk management is undertaken in the Australian coal mining industry.

4. Methodology

The methodology undertaken for the project was to use literature reviews, direct observation, structured interviews, questionnaires, and brain storming to identify and document examples of best practice risk assessment techniques within the Australian coal mining industry.

Key health and safety professionals from the coal mining industry were contacted and questioned to determine a representative sample of best practice mines. The interviews with the key health and safety professionals provided important contextual information and assisted in the selection of the eleven sites. Five sites were identified in the Hunter Valley in New South Wales and six in the Queensland Bowen Basin. The number of sites was evenly divided between open cut operations and underground mines.

Interviews

Cooperation form mining companies and mine site personnel was very high. Structured interviews were conducted on each site visited with key personnel including:

- Mine Managers;
- Site Health and Safety Managers;
- Technical staff; and
- Mining operations staff.

In addition corporate HSE managers were also interviewed regarding health and safety management systems. Project highlights include:

- Site visits to both underground and open cut mines to observe and interview mine personnel regarding occupational health and safety and risk management.
- Development and administration of a questionnaire on risk management strategies developed, pilot tested and administered to a number of coal mines regarding on site occupational health and safety risk management techniques and practices.
- Direct observation of risk management techniques and practices on site including risk assessments at various coal mines.
- Development of a risk assessment data base.

Project Milestones

The results of the project have been extremely positive. Cooperation from mining companies and mine site personnel has been extremely encouraging. The Project leader has visited various mining sites in several states. There was a high willingness to participate in the project and to share occupational health and safety risk management information. Specific milestones of the project included:

- Literature review conducted regarding occupational health and safety risk assessment and management strategies within the mining and other sectors;
- Collation of the literature review and draft out line of risk management package including the development of a preliminary hazard listings for both open cut and underground coal mines have been developed;
- Identification of whole of life risk management cycle for mines that will be incorporated into the finished report and risk management package;
- Questionnaire on risk management strategies developed, pilot tested and administered to a number of coal mines on site occupational health and safety risk management techniques and practices;
- Project leader has interviewed on site operational staff of mining companies to determine current risk management practices and to gather best practice case studies;
- Direct observation of risk management techniques and practices on site including risk assessments at various coal mines;
- Other occupational health and safety risk management data and case studies gathered from various coal mines and mining companies; and
- Development of risk management data base.

5. Results – an Overview

Although this project was essentially a modest one, the level of co-operation from the industry has been very high. Both organisations and individuals have been particularly keen to participate in the on site activities. From the many site visits, discussion groups, presentations and workshops it is possible to draw some inferences on both the type and level of risk assessment and management activities being conducted across the sector.

All of the sites visited had extensive health and safety management systems, corporate HSE policies and risk management processes. All had internal quality control processes including internal OHS audits. However, some mines excelled in areas such as consultation and involvement of employees, implementation (as opposed to paper systems) and follow up and feedback to employees.

Most of the organisations contacted for this project have risk management programs exceeding regulatory requirements. However, the level of commitment and resources allocated to the risk assessment and management processes did vary across the coal mining sector. Of particular interest however was the standard of risk management and levels of commitment which also varied across mine sites within the same mining organisation.

The commitment by senior management to health and safety and the management of risk was identified by several mines as the most critical factor in determining the success and uptake of the risk management program. If the senior management of the mine was committed to safety, did not tolerate safety violations and demonstrated commitment by applying time, people and resources to OHS risk management then the rest of the mine viewed it as important and this generally ensured a high level of commitment throughout the mine.

Conversely if the senior management of the mine said they were committed to safety (as invariably all of them did) but they tolerated safety violations, did not lead by example, and did not allocate sufficient time, people and resources to managing OHS risks then the rest of the mine viewed safety as something to be done but certainly not as important as production and profit.

Crucially, the level of commitment to health and safety by senior management directly influenced the attitudes of middle management within the mine. Middle management is often charged with making the decisions, such as the allocation of people to health and safety risk management activities. This allocation is often balanced against production pressures.

In mines where there is significant senior management support for OHS risk assessment and management activities production and technical staff were more likely to be available for and turn up to OHS risk management activities. It was often cited by technical and production staff that were interviewed for this project that in many cases if they were approached to undertake an OHS activity the attitude of their boss would directly determine if they went along or not. This attitude was observed in almost every mine visited as part of this project.

Therefore one of the main drivers identified for successful risk management processes and continued improvement in OHS is the visible commitment by senior and middle management to health and safety and by making time, people and resources available for OHS risk management.

This theme has come up as a consistent issue when talking to OHS managers and mining staff and is a key strategy for future research.

6. Risk Management Manual and Data Base

The major outcome of this project is a risk management manual and data base for the Australian coal mining industry. The manual and data base contains practical advice, guidance and tools a to assist risk managers and OHS professionals working within the coal mining industry to better manage their own organisation's risks with the aim of reducing the incidence of occupational injury and disease. This will result in better risk management outcomes, improved health and safety and savings in valuable time and effort for all coal mines. The manual includes:

- A detailed overview of risk management processes in relation to coal mining;
- A best practice methodology detailing aspects of hazard identification, risk assessment and control in coal mines;
- Development of comprehensive hazard listings for underground and open cut mining processes;
- Practical checklists for conducting and recording the results of risk assessments;
- A data base for the risk ranking of specific mining hazards; and
- Worked examples of specific hazards using identified methodologies.

7. Overview of Key Mining Risks

During the course of the literature review, it became necessary to undertake the development of a listing of risks associated with coal mining so that the key risks associated with mining activities could be identified. Relevant legislation, data bases and statistical publications were reviewed to identify the key risks associated with coal mining.

As a starting point, relevant health and safety legislation contains listings of notifiable incidents. These notifiable incidents are in fact high level codified risks that are required to be actively managed. A listing of notifiable incidents from relevant Australian coal mining legislation is below:

The Queensland Coal Mining Safety and Health Regulation (2001)

The Queensland Coal Mining Safety and Health Regulation (2001) list the following as types of serious accidents and high potential incidents:

- Unplanned ignition of gas, dust, or a combination of gas and dust;
- Damage to, or failure of, haulage equipment used to transport a person in a shaft or slope, if the damage or failure causes a hazard;
- The failure in service of explosion protection of explosion protected equipment;
- A failure of electrical equipment or an electrical installation causing an electric shock to a person;
- An unplanned ignition or explosion of a blasting agent of explosive;
- A major structural failure of equipment, if the failure causes a hazard;
- Spontaneous combustion of coal or other material in an underground mine;
- An inrush;
- A major failure of strata control; and
- The entrapment of a person.

The NSW Coal Mines (Underground) Regulation 1999

The NSW Coal Mines (Underground) Regulation 1999 list the following as types of Notifiable incidents in underground coal mines:

- An electric shock to a person from a source that is above extra low voltage (as defined in AS/NZS 3000:2000, *Electrical Installations* (known as the Australian/New Zealand Wiring Rules));
- An unplanned movement of a vehicle, machine or any item of plant or equipment such as to endanger persons or cause serious property damage;
- A failure or collapse of any structure such as to endanger persons or property;
- An event that occurs in a hazardous zone and leaves visible evidence on an electric cable of arcing having occurred;
- An unplanned fall of roof or sides of a mine that impedes passage or disrupts mine ventilation;
- A windblast that results in injuries requiring first-aid treatment;
- The entrapment of a continuous miner by a fall of roof or sides such that it is unable to be recovered under its own tractive effort;
- The entrapment of a breaker line support by a fall of roof such that it is unable to be recovered under its own tractive effort;
- A creep, progressive pillar collapse or significant deviation from predicted surface subsidence; and
- The in-service failure of the explosion protection characteristic of explosion protected apparatus located in a hazardous zone.

The NSW Coal Mines (Open Cut) Regulation 1999

The NSW Coal Mines (Open Cut) Regulation 1999 list the following as types of Notifiable incidents in Open Cut coal mines:

- An outbreak of fire endangering persons or causing serious property damage;
- Initial self-heating of the coal strata or overburden in a part of a mine;
- An abnormal inrush of water, or material that flows when wet, from any source such as to endanger persons or property;
- The receiving by a person of an electric shock from a source, or the suffering by a person of burns received from an electric circuit, that is above extra low voltage (as defined in Australian Standard 3000 *(SAA Wiring Rules)*);
- The suffering by a person of bodily injury occasioned by an explosion or discharge of blasting material;
- An unplanned movement of a vehicle, machine or any item of plant or equipment such as to endanger persons or cause serious property damage;
- A fall, slumping, loss of strength, failure or collapse of the high wall, low wall or spoil area such as to endanger persons or property;

- A failure or collapse of any structure such as to endanger persons or property;
- An in surge of noxious or flammable gas from old workings; and
- The ejection of fly rock outside the boundary of a mine's lease area during shot firing such as to endanger persons or property.

Additional Relevant Australian Coal Mining Publications

In addition to relevant legislation statistical publications were also reviewed to identify the key risks associated with coal mining.

Queensland Resources Council

The Final Report to the Queensland Resources Council on Underlying Causes of Fatalities and Significant Injuries in the Australian Mining Industry (MISCH, 2005) list the following major causes of fatalities and significant injuries in the Australian Mining Industry:

- Single and multiple vehicle accidents;
- Fall of ground;
- Persons crushed in machinery;
- Persons falling from heights; and
- Persons hit by objects or substances.

BHP Billiton

BHP Billiton has identified developed fatal risk protocols to eliminate the risk of fatalities and injuries arising from particular hazards or activities for their mine sites. These include protocols for:

- Light vehicles;
- Surface mobile equipment;
- Underground mobile equipment;
- Underground ground control;
- Hazardous materials management;
- Equipment Safeguarding;
- Isolation;
- Working at Heights; and
- Lifting Equipment.

Queensland Department of Mines and Energy

The Queensland Department of Mines and Energy – Queensland Mines and Quarries Safety Performance Report 2005/06 identifies the following absent / failed causal factors associated with high potential incidents:

- Loss of control / unplanned movement;
- Fire;
- Electrical;
- Vehicle;
- Fall of ground;
- Falling / flying material;
- Equipment structural failure;
- Mobile Plant;
- Person Falling;
- Explosion;
- Winding, haulage or conveyor;
- Noxious / asphyxiating gas;
- Hydraulic compressed air;
- Physical work environment;
- Physiological / Psychological;
- Inrush / inundation;
- Chemical;
- Hot surface material;
- Gas ignition;
- Lightning strike;
- Biological;
- Gas Outbursts; and
- Spontaneous Combustion

8. Summary of Key Coal Mining Risks

The purpose of the table is to identify key health and safety risks that are common to most organisations in the Australian coal mining industry. The listing of risks in the table below was developed using best practice case studies and a literature review. This list is intended to assist coal mining organisations and personnel by identifying key risks. This will enable coal mining organisations and personnel to quickly assess their risk management processes and registers and ensure that these key risks (at a minimum) are included, monitored and reviewed on an ongoing basis. The risks are listed in alphabetical order.

Table 2: Key Mining Risks

Key Coal Mining Risks	
Risk	**Additional Descriptions**
Biological	
Biological	Tetanus
	Viral
	Fungal
	Hep A, Hep B
	E. coli
Electricity	
Electric Shock	A failure of electrical equipment or an electrical installation causing an electric shock to a person
Emergency Management	
	Lack of resources
	Lack of planning
Equipment	
Equipment safeguarding	The entrapment of a person
Persons crushed in machinery	Lack of guarding
	Ineffective guarding
	Working on moving parts with guarding removed
	Lack of risk assessment
	Persons hit by objects or substances
	Hot surface material
	Hydraulic compressed air
	Loss of pressure
	Loss of control / unplanned movement
	Improper isolation of equipment
Equipment Structural Failure	A major structural failure of equipment, if the failure causes a hazard

Explosion / Ignition	
Explosion	An unplanned ignition or explosion of a blasting agent of explosive
Gas ignition	Unplanned ignition of gas, dust, or a combination of gas and dust
Falling / Flying Material	
Falling / flying material	The ejection of fly rock such as to endanger persons or property.
Fire	
Fire	On mobile equipment On fixed plant Underground
Gas Outbursts	
Gas Outbursts	An in surge of noxious or flammable gas from old workings
Hazardous Substances Management	
Hazardous Substances management	Poor handling practices Poor storage practices Poor transporting practices Inappropriate use Inappropriate labelling
High Wall	
High Wall	A fall, slumping, loss of strength, failure or collapse of the high wall, low wall or spoil area such as to endanger persons or property,
Inrush / Inundation	
Inrush / inundation	An inrush of water An inrush of mud
Isolation	
Isolation	Failure to identify or recognise a source of potential or stored energy Inadequate training or competence Complacency Inadequate lock out tag out systems Working on or isolating the wrong equipment
Lightning strike	
Lightning strike	Electrocution Electrical Arc
Physical Work Environment	
Physical work environment	Heat Noise Mist Vehicle exhaust Dust
Psychological	Stress
Radiation	
Radiation	Electric arcs Lasers High frequency magnetic fields

Spontaneous Combustion	
Spontaneous Combustion	Spontaneous combustion of coal or other material in an underground mine
Structural Collapse	
Structural Collapse	A failure or collapse of any structure such as to endanger persons or property.
Surface Mobile Equipment	
Surface mobile equipment	Overtaking Loss of traction Overturning Reversing Unplanned movements on slopes Parking protocols Ineffective communications Poor visibility Persons hit by objects or substances Dropped loads Structural failure Loss of control / unplanned movement Operator fatigue
Underground Ground Control	
Fall of ground	Unplanned fall of roof or sides of a mine that impedes passage or disrupts mine ventilation Entrapment of a continuous miner by a fall of roof or sides such that it is unable to be recovered under its own tractive effort Entrapment of a breaker line support by a fall of roof such that it is unable to be recovered under its own tractive effort Persons hit by objects or substances A creep, progressive pillar collapse or significant deviation from predicted surface subsidence A major failure of strata control
Underground Mobile Equipment	
Underground mobile equipment	Interactions between vehicles and pedestrians Unplanned movements of vehicles down inclines and slopes Poor visibility Speed Persons hit by objects or substances Loss of control / unplanned movement Rolling and tipping of vehicles Poorly maintained road surfaces

Vehicles	
Vehicle	An unplanned movement of a vehicle, machine or any item of plant or equipment such as to endanger persons or cause serious property damage, Light vehicle / Heavy vehicle interactions Speed High centre of gravity Rolling and tipping of vehicles Persons hit by objects or substances Multiple vehicle accidents Driver fatigue Failure to wear seat belts Lack of protective devices Poorly maintained road surfaces
Ventilation	
	Inadequate ventilation Airborne particulates
Windblast That Results in Injuries	
Windblast that results in injuries	
Winding, Haulage or Conveyor	
Winding, haulage or conveyor	Persons hit by objects or substances
Working at heights	
Working at heights	Persons falling from heights Failure to wear fall protection Wrong sort of harness Incorrect use of fall protection Lack of job planning and assessment Unstable work platforms

9. Risk Management - What is being done well?

In many areas the coal mining industry in Australia leads the way in the management of occupational health and safety risks. Some of the many positives identified during the project include:

- Risk assessment is part of the culture of the Australian coal mining industry;
- Risk assessments were observed being undertaken at various levels within organisations and across sites;
- Risk assessment processes and risks associated with major hazards are generally well documented within the Australian coal mining industry;
- Risk assessment methodologies used across the industry conform to either the methodology contained in the *Australian Standard for Risk (AS/NZS 4360:2004) or the methodology in AS/NZS 4801:2001;*
- Cooperation on safety between organisations is common. There are strong networks within the industry and health and safety information is shared routinely between many organisations;
- Staff interviewed like solving problems and being involved if they were heard and their advice was acted upon;
- Job Safety Analysis and personal risk assessments are used routinely on any sites to assess personal risks;
- Risks are regularly reviewed and audited;
- Major mining hazards are generally well understood by mining personnel;
- There is a 'focus on failure' in successful organisations. They are mindful of risks and injuries and are constantly reviewing controls and processes;
- While risk management can be an expensive process, resources are being committed by organisations;

- Corporate HSE systems provide minimum bench marks for the assessment and management of OHS risks which provide guidance and assistance to individual mine sites on how to manage risks;
- Employees are trained and involved in personal risk assessments such as job safety analysis;
- As an industry we are becoming more sophisticated in our approaches to the management of risk; and
- Cooperation on safety issues between mining organisations is more common than generally noted in other industries.

10. Risk Management - What can be improved?

Some of the major criticisms identified during the project regarding risk assessment activities include:

- They are used to justify decisions that have already been made. This severely reduces the credibility of the risk management process with employees and jeopardises future cooperation and risk management outcomes;
- Generic processes are used when there are site specific conditions that require and individual approach be taken. This is particularly true if risk assessments are taken from one site and used at another without careful review and input by the site employees;
- Risk assessments are being conducted on a push basis (fear of non compliance with legislation) rather than a pull basis where the organisation believes that it is good for business to manage safety properly and undertake risk assessments;
- Risk management programs are often poorly targeted, not evaluated or followed up to ensure that they have delivered value for money as well as safety improvement are wasteful.
- Assessments are conducted that only consider the risks associated with one activity. Cumulative or concurrent risks are generally not identified and assessed very well.
- Failure to identify all hazards associated within an activity. Due to rushing, poor planning or a lack of data.
- Managers do not always release staff to participate. Production pressures mean that employees who would have valuable information to contribute are not always involved;
- Managers and supervisors are not always involved in the risk assessment and so their valuable knowledge and experience is not always available.
- Production pressures sometimes mean that personnel are dragged out of a risk assessment.

- Chronic health issues (such as noise) are generally not as well recognised and assessed as acute safety issues;
- Poor planning and communication on site sometimes detracts from the risk assessment process. Staff are sometimes not given adequate warning that a risk assessment is being undertaken.
- Some staff did not feel they were adequately trained to undertake the risk assessment process;
- Many staff were not easily made aware of how a risk assessment links directly to their safety. This lead to feelings of disconnection and questioning of the process; and
- Poor communication. Some employees felt that not everyone is informed of the outcomes of a risk assessment and that feedback could be improved.

However the major pitfall associated with current risk management practices identified during the literature review (and supported by discussions with mining staff) was that in some circumstances mine management did nothing with the results of a risk assessment.

Several persons interviewed indicated that although some good solutions to health and safety issues were raised by the employees, quite often nothing was done to implement the control or that excessive costs were used after the assessment to justify doing nothing and maintaining the status quo.

It is not enough to simply undertake a risk assessment. The organisation must be active and ensure that controls are implemented, that they are chased up, monitored and feedback provided to those who have been involved in its assessment. Champions, not policemen, are needed to monitor and review risks and the implementation of controls.

11. Conclusions

Risk management in coal mining is a complex business. Regulatory regimes and society are becoming less tolerant of risk. Overall the effective management of OHS risks will have significant benefits for the community, organisations and individuals.

If we as a society can adopt and effectively implement best practice OHS risk management principles, we can make the workplace safer, improve productivity, increase quality, remain competitive and raise the standard of living for all Australians.

In addition there is an increased readiness within society for retribution and compensation. No organisation can afford to just pay lip service to the process of managing OHS risks. Effective risk management relies on:

- Senior management commitment to demonstrate that safety is important and that risk management is a critical issue.
- Organisations that create a culture of organisational mindfulness where there is a preoccupation with failure (where failures no matter how minor provide an opportunity to learn) and see the reality of danger in a near miss are likely to mange their risks more effectively (Wiek, 1999).
- Resources to make it happen. Risk assessments can be time consuming and expensive but the alternative is worse.
- Trained HSE personnel and champions not only to undertake the risk assessments but to drive the need to control risks effectively throughout the organisation.
- Staff, who understand the operations and are trained in risk management must be involved in risk management activities.
- Champions, not policemen, to monitor and improve risk management
- Commitment by all of those involved in the process to achieving better risk management outcomes
- Goodwill from mining staff to participate and recognition that risk management is about their own health and safety

- Demonstrating that the time spent on risk management is an investment
- Follow up, monitoring and review. Senior management must be involved and make it happen.

12. Recommendations

These simple messages of commitment, organisational mindfulness, adequate resources and training are communicated to senior management, supervisors and health and safety professionals to ensure that risk management efforts are effective.

Supporting senior and middle management may be the best way of supporting lasting cultural change aimed at improving health and safety performance within the coal mining industry.

As middle management has a key role to play in the risk management process a way forward would be to develop additional strategies to assist middle management to drive health and safety improvement within the coal mines.

This could be in the form of training packages for middle managers targeted at understanding the five key priority areas nominated by the Coal Services Health and Safety Trust and what can be done at an individual mine level to improve performance in these areas.

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Appendices.

Appendix One: Comparative Health and Safety Statistics

Queensland Coal Mining – Underground Coal Mines Comparative Data

Year	LTIFR	No. of injuries	Days lost	Severity rate	Injuries per million tonnes	Disabling injuries	High potential incidents
2004/05	11.8	87	1405	191	2.5	154	63
2005/06	12.1	101	2863	344	2.9	236	123

Source: Queensland Mines and Quarries Safety Performance and Health Report1 July 2005 –to 30 June 2006 (Department of Mines and Energy 2006)

Queensland Coal Mining – Surface Coal Mines Comparative Data

Year	LTIFR	No. of injuries	Days lost	Severity rate	Injuries per million tonnes	Disabling injuries	High potential incidents
2004/05	3.1	90	2681	94	0.5	101	290
2005/06	2.8	106	2009	53	0.6	169	451

Source: Queensland Mines and Quarries Safety Performance and Health Report1 July 2005 –to 30 June 2006 (Department of Mines and Energy 2006)

New South Wales Coal Mining Health and Safety Data

Year	LTIFR*[1]	No. of injuries[1]	Severity rate[1]	Duration rate[1]	Serious Body Injuries[2]
2003/04	21	413	451	28	12
2004/05	18	376	394	29	9

*all coal rates (underground and open cut)
Source 1: Industry Performance Measures, Quarterly Report 2005, New South Wales Department of Primary Industry.

Source 2: New South Wales Department of Primary Industry Annual Report 2004/05, 2005, New South Wales Department of Primary Industry.

New South Wales Coal Mining LTIFR Comparison Underground v Open Cut

Year	Open Cut LTIFR[2]	U/G LTIFR[2]	No. of LTI's[1]
2003/04	9	33	443
2004/05	8	27	565

Source 1: Industry Performance Measures, Quarterly Report 2005, New South Wales Department of Primary Industry.

Source 2: New South Wales Department of Primary Industry Annual Report 2004/05, 2005, New South Wales Department of Primary Industry.

New South Wales Coal Mining Compensation Data

Year	No of claims	Total cost	Cost / claim
2003/04	4539	79,180,805	17,445
2004/05	4093	72,579,826	17,733

Source: Safety Performance Report of the Australian Minerals Industry 2004-05 (Minerals Council of Australia