International Mining Fatality Database

Project Report

Overview of the project undertaken at the NSW Department of Primary Industries as a vacation industrial work experience project

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DISCLAIMER

Much of the information contained in this report and the fatalities database has been sourced from the NSW Department of Primary Industries. The Department acknowledges that there may be alternative interpretations on some of the categories selected throughout the database. This must be taken into account by each individual user of the database. This database is as complete as possible, given the amount of material both publicly and privately available to the compiler.

Complete and correct statistical analysis can only be done between periods where records are fully complete and there are no missing incidents. Just because a time period or state does not have any recorded incidents does not mean there were no fatalities in that state during that time.

A full disclaimer on the publication of information on the Department's website is available at:

www.dpi.nsw.gov.au/aboutus/about/legal/disclaimer

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INTRODUCTION

Mining fatalities are still occurring around the world every year as regular occurrences. Although the reasons for these are varied and different, better ways to analyse these incidents are needed in order to prevent commonly repeating patterns of incidents. When deciding what would be the most appropriate incidents to analyse, fatalities were decided to be the best choice. When comparing different countries, legislation regarding LTI and injury management causes incomparable differences and leads to over or under reporting. A fatality is an event which cannot be over or under reported and is a major event which needs to be considered.

The point of this project was to extend on the current database of incidents, which have caused fatalities and that can be easily accessed by everyone in the industry. The database, as it was currently available, contained some 1200 incidents and 2400 fatalities from Australia and around the world. This has been extended well beyond this and at project completion has reached over 2800 incidents with some 13800 fatalities. Different states and countries have different levels of coverage depending on what data was able to be found, or was made available by those states and countries.

The Australian states of New South Wales and Queensland and New Zealand have complete coverage of all mining fatalities between 1957 and 2007. Western Australia and Tasmania have complete coverage of all fatalities between 1980 and 2007. South Australia, Victoria and the Northern Territory have complete coverage of all fatalities between 1998 and 2007. The United States has complete coverage of every fatality between 1995 and 2007. The United Kingdom, Canada, Poland and China have some fatality records also included, depending on availability.

An incident which occurs in another state and country can sometimes go without a notice, often appearing on a website only. It also may occur that after an incident, over time, it is forgotten about and the same poor practices may re-emerge. This database is a preventative measure to ensure that records of incidents causing fatalities are kept fresh and accessible for the mining industry and its suppliers. This is so a

repeat of a previous incident does not have to happen before steps are taken to correct an improper design management system and/or procedure. Prevention of an event taking place again is always better than rectifying the situation after it has taken place.

It is anticipated that this database could be used for not only risk assessments, but also for many other projects such as for equipment designers and manufacturers to determine numbers and types of fatalities which have happened on the types of equipment being designed. This will allow designers and manufacturers to target specific problem areas on that equipment. It can target operational and maintenance issues which individual mines may have. It can be used in legislation and standards development, and already has been used for this specific purpose. It can be used to help improve hazard perception training and also in enforcement actions. It can show trends in fatalities in the mining industry and can be used as a prediction tool by inspectors to identify particular trends which have come up in the past.

The methods used for data collection were through online databases, internet articles and reviews, data from studies and private databases kept by interested individuals in the mining industry. Some database information from state and international government records, and also newspaper and regular mining industry reports were available.

The database encompasses incidents which happened from the last 142 years; however the major amount of the data is from the period of 1980 through to 2008. Data from 16 countries is present in the database and these seek to give both the comprehensive data from Australia and the United States along with a brief survey of data from other countries worldwide.

The purpose of the database is to provide the mining and quarrying industries, equipment designers, manufacturers and suppliers and regulators with a readily accessible and easily searchable, source of information. This will assist in identifying target areas for design, operational issues, maintenance, training, legislation development and enforcement action. In particular it is regarded as an important step in preparing for risk assessments and management processes.

RESEARCH AND INVESTIGATIONS

Australian Standard – AS 1885.1-1990

The Australian Standard for workplace injury and disease recording standard is AS 1885.1-1990. This is a standard which is recommended for minimum information which should be recorded by employers on work injury and disease occurrences. This standard keeps the reporting of injuries along a constant track and provides employers with a recording form to ensure all required information is attended to.

It was decided to look at the possibility of keeping all of the fatality records in line with the Australian Standard of workplace injury reporting. This would have provided a written series of protocols for how data is reported. Keeping the database in line with an Australian standard would immediately make the information much more of a benchmark in the industry. There however were some problems which were struck while attempting to do this.

Reporting data by this standard is a very effective way of keeping records of worker information, but less regarding the accident. The problem with this was that this database looks only at fatalities, so one of the major strength's of the standard would be immediately made redundant. This standard is based on all types of incidents within the Australian workplace and the broad categories, which cover all industries has very little relevance to the mining industry. This would decrease the potential uses of the database upon completion due to a lot less detail regarding incidents. Much of the collected data was not prepared according to this standard, both due to the date of the incident, but also because in fatal accidents, an investigation is performed more often than non-fatal incidents being reported by a workplace. This would leave a greater percentage of the Australian data, let alone all overseas data not adhering to the Australian standard. It would therefore be no use to try to use the Australian standard if the data being used in that document was not written to the standard.

Even though the database has not been written in line with the Australian standard, all of the movements away from this standard have been to make the database more

usable. Changing the categories to a more mining industry friendly terminology will allow the user to obtain more in-depth view with a wider scope for possible analysis.

COUNTRIES INVOLVED

Following on from previous research performed on this same project, finding new information initially proved difficult. The report written by my previous colleague assigned to the database project gave me some leads on finding data. Many of the internet links no longer existed, however there were some newer records available.

Countries which have extensive records contained within the database

- Australia
- New Zealand
- United Kingdom
- United States

Countries which have limited records contained within the database

- Canada
- China
- France
- Germany
- India
- Japan
- Poland
- Russia
- South Africa
- Ukraine
- Yugoslavia
- Zimbabwe

ONLINE DATA SOURCES

Some of the data sources used for the database was from websites which are no longer currently available on-line. These have not been included in the list. However these websites which are not available are not concerning data from Australia, New Zealand, the United Kingdom or the United States.

Australia

New South Wales

Department of Primary Industries

COMET database within DPI – Not accessible to the public

Queensland

Department of Minerals and Energy

www.dme.qld.gov.au/mines/publications_forms.cfm

Western Australia

Department of Consumer and Employment Protection

www.doecp.wa.gov.au/resourcessafety/Sections/Mining_Safety/pages/Western_Australian_M.html

South Australia

Voice of Industry Death

www.void.org.au/convictions.htm

Victoria

Worksafe Victoria

www.worksafe.vic.gov.au/wps/wcm/connect/WorkSafe/SiteTools/About+WorkSafe/Statistics/

Northern Territory

Department of Employment, Education and Training

http://www.nt.gov.au/dpifm/Minerals_Energy/Content/File/Statistics/200709_NT_Minerals_Industry_Quarterly_Report_Q4_06_07.pdf

Tasmania

Department of Energy, Infrastructure and Resources

www.mrt.tas.gov.au/portal/page?_pageid=35,832417&_dad=portal&_schema=PORTAL

UNITED STATES

Mine Safety and Health Administration

www.msha.gov/fatals/fab.htm

UNITED KINGDOM

Health and Safety Executive

www.hse.gov.uk/mining/accident/index.htm

RUSSIA

http://en.wikipedia.org/wiki/Ulyanovskaya_Mine_disaster

http://en.wikipedia.org/wiki/Yubileynaya_Mine

Historical References

Illawarra Coal

www.illawarracoal.com/disasters.htm

Coal Services

http://coalservices.com.au/index.php?option=com_content&task=view&id=7&Itemid=92

Fatalities in the Australian Mining Industry

www.minerals.org.au/_data/assets/pdf_file/0005/4892/Fatality_Retro_Dec02.pdf

United States Mines Rescue Association

http://www.usmra.com/saxsewell/historical.htm

Further information has been received from closed data records, gained by communication with various groups and government departments around the world. This information is accessible in more detail in the extensive records attached to this report.

CATEGORIES

These categories have been created based upon the required outputs of the data. They allow the user to easily search large amounts of data and come up with the most useful set of statistics.

- Incident Date
- Mine Type
- Operation Type
- Country
- State
- Mine Name
- Agent of Fatality
- Equipment Involved
- Equipment Fit For Purpose Aspects
- Activity at Time of Accident
- Accident Location
- Management or Human Behaviour
- Number Killed
- Occupation of Deceased
- Summary of Events
- Recommendations

The database user is able to find all information based on any of the categories listed above. This allows for large amounts of data to be processed and sorted quickly into categories from which the most important facts can be drawn. Once a data record is found, it must be broken down into categories to aid the users to easily search through records. This is to gain specific information about incidents such as mine type, operation type, equipment involved and the agent of fatality.

Occupational diseases (e.g. asbestosis) are not taken into account within this database because they are not fully quantifiable and there may be a secondary and tertiary cause. Fatalities in this database were all work related traumatic incidents which occurred on-site and there was a direct link between the root cause and the incident.

COMPLICATIONS

The major problem was that different states have different rules regarding the release of information regarding mining incidents. In Australia every state is its own entity, so different states have different rules about freedom of information. There were some states within Australia which were either unable, due to legal reasons, or unwilling to provide information to assist this project. The United States provided the easiest to decipher databanks of information as they have one department, The Mine Safety and Health Administration (MSHA) which manages all of the records about the mining industry. The mining industry in the United Kingdom is governed by the Health and Safety Executive (HSE), and they have strict rules about the release of information, especially that relating to current investigations.

Finding statistical information about different countries was not very difficult, however finding the actual fatality reports along with the accidents root-cause was the major hurdle. As this project was not a statistical analysis but a detailed analysis using actual incident information, fatality reports were required.

Statistics shown within this report are based upon data collected and not necessarily all incidents which have occurred. This needs to be taken into account when using the data for specific countries, time periods and comparisons. It is anticipated however that there is enough data available to give realistic trends in most categories.

There is currently no publicly available database like this anywhere in the world, other than a few privately held databases with limited records. It was difficult to determine how much information should be included in this database. This was because some of the data had great amounts of detail; however other records had very little information to describe an incident. This has created a disparity in some of the data, as some records have comprehensive detail and some have very little. Not including the records with very little information however would decrease the ability of the databases use in trend recognition and statistics.

RESULTS

Reports have been developed which give a summary of all the incidents such as the agent of fatality breakdown, the equipment involved, the accident location and the activity at the time of the accident. There has also been the split into Coal mining and Non-Coal Mining Incidents; Underground and Open Cut incidents.

AGENT OF FATALITY (HAZARD/ENERGY SOURCE)

The agent of fatality is the root cause of death in the accidents. Although the root cause of death varies between mine operations, there is a clear definition of the dominant causes of death. The table below is a summary of agents of fatalities and the number of incidents for the international countries reviewed. In cases where there were multiple agents of fatality, the primary agent was used.

Table 1: Agent of Fatality Summary.

Agent of Fatality	**Number of Incidents**
Asphyxiation	91
Catastrophic Failure	27
Contact with Moving or Rotating Plant (Guarding/Access to Danger Zone)	289
Drowning	76
Electrocution	127
Explosives	62
Fall From Heights	260
Fall of Roof/Sides/Highwall	683
Fire	37
Gas Ignition Explosion	147
Inrush	19
Other	421
Other Explosion	29
Outburst	24

Pressure Vessel Explosion	7
Tyre Explosion	14
Uncontrolled Release of Energy	87
Unintended Operation of Equipment	359
Unknown	46
Windblast	3
	2808

The main root cause of death in mining operations as seen from the review is Fall of Roof/Sides/Highwall and accounts for approximately 24% of all mining fatalities. Unintended Operation of equipment follows second accounting for 13% of all mining fatalities and Fall from Heights third at 9%

EQUIPMENT INVOLVED

Equipment Involved is any equipment or plant involved in the accidents or that was being operated in the vicinity contributing to the accident. In the mining industry there is a wide variety of equipment, which is too extensive to be fully accommodated and hence must be compacted into broad categories.

The table below summarises the number of incidents that have occurred with the type of equipment involved. From the review it is evident that almost every mining fatality has some involvement with equipment. Approximately 77% of all mining accidents resulting in a fatality have occurred involved equipment. The design and fit for purpose equipment is a very important aspect to be analysed and focusing on this area is an important way to reduce fatalities. Some important factors of the equipment is that once equipment is found not to be fit for its purpose it should be re-designed or modified to become fit for purpose. This ultimately falls under an individual mines responsibility, and should become a part of each mines culture of safety. Designers and manufacturers should be using incident data information such as that contained within this database for initial design, future modifications and changes in equipment design to ensure it is as safe and fit for purpose as far as possible.

Table 2: Summary of Equipment involved in Mining Fatalities.

	Equipment Involved	**Number of Incidents**
1	Access	40
2	Belt Conveyor	92
3	Bins	43
4	Buildings/Structures	52
5	Continuous Miner	129
6	Cranes/Lifting	82
7	Crushers	33
8	Cutting and Welding	31
9	Drill Rig	106
10	Earthmoving Other	94
11	Electrical Equipment	64
12	Excavator/Dragline/Shovel	54
13	Handheld Equipment	71
14	Load Haul Dump - LHD	245
15	Longwall	28
16	Man Transport	23
17	No Equipment	633
18	Non-Belt Conveyor	17
19	Other	325
20	Process Plant	5
21	Pumps/Compressors	22
22	Shuttle Car	47
23	Stockpiles	17
24	Trains/Locos	108
25	Truck	258
26	Unknown	177
27	Winders	12
28	Workshop	0
		2808

The main equipment type involved in mining fatalities is Trucks (9.2%). All haul trucks, service trucks and on-highway trucks were defined as the one incident type. The next equipment type that is involved in fatalities that follows trucks is Load Haul Dumps (LHD). LHD's account for only 8.7% of all mining accidents although they are considered to be the second most likely equipment involved in mining fatalities.

ACCIDENT LOCATION

There are many locations within a mine site where a fatality can occur. A combination of poor safe work procedures, equipment movement and operation and unexpected ground movements, can be the result in many fatalities. Mine locations have been summarised in the table below and the respective number of fatalities for all mines internationally.

With a total of around 13800 fatalities considered in the review there is a variety of locations where fatalities have occurred. The 'Other' Location accounts for any location other than the ones listed in the table. Such locations include mine shaft, other buildings and exploration areas, where the numbers of fatalities are limited.

Table 3: Summary of Number of Fatalities with Respect to Location in Mine.

Location	**Number Killed**	**Number of Incidents**
Dam/River	44	44
Mining Area	11329	1154
Other	592	433
Process Plant	266	260
Road/Roadway	423	397
Surface	108	104
Unknown	961	311
Workshop	92	91
Yard	15	14
	13830	**2808**

From Table 3 it is evident that the majority of fatalities occur within the mining area. The mining area is the main location for fatalities at underground mining operations. At the Mining Area, 41% of the incidents occur, however 82% of the fatalities occur in the mining area. This very high number is due to the multiple fatality incidents which more frequently transpire in the mining area. Roads and Roadways are the next place a mining fatality is most likely to occur, with 13% of the incidents, but only 4% of the fatalities. These incidents however are usually only single or double fatalities and cause a higher percentage of incidents than fatalities. Because transport is of high importance in mining operations, roads and roadways are susceptible to the occurrence of fatalities.

ACTIVITY AT TIME OF ACCIDENT

Activities at time of the mining accident are an important category to consider when conducting an International Mining Fatalities Review. It is important to know and understand what victims were doing at the time of the incident so equipment, work procedures and management of safety can be improved.

Common activities and the associated number of fatalities are summarised in the table below.

Table 4: Summery of Number of Fatalities with Respect to Activity at Time of Accident.

Activity	**Number Killed**	**Number of Incidents**
Loading/Unloading	90	87
Maintenance	628	551
Other	333	224
Production	9746	639
Support Services	406	376
Transport	529	472
Unknown	2098	459
	13830	**2808**

A large percentage of mining time is spent on production activities and it is the most dangerous activity being performed throughout the mine. Production activities account for approximately 23% of all mining incidents, but 70% of mining fatalities.

COAL MINING FATALITIES

Coal mining is a major worldwide industry employing over 7 million people worldwide and is performed in some very dangerous locations. Coal mining fatalities however within this data are skewed, due to the prevalence of gas ignition explosions which have cost the lives of hundreds, even thousands of miners in single horrific incidents.

The following table is a summary of Coal Mining Fatalities internationally.

Table 5: **Summary of International Mining Fatal Incidents from Coal Mines**

	Underground	**Open Cut**	**Unknown**	**Total**
Australia	919	86	0	**1005**
China	2565	0	0	**2565**
France	1060	0	0	**1060**
Germany	299	0	0	**299**
India	1053	0	0	**1053**
Japan	1465	0	0	**1465**
New Zealand	63	5	13	**81**
Russia	147	0	0	**147**
South Africa	437	0	0	**437**
Ukraine	244	0	0	**244**
United Kingdom	1598	6	4	**1608**
United States of America	1315	152	93	**1560**
Yugoslavia	195	0	0	**195**
Zimbabwe	427	0	0	**427**
	11787	**249**	**110**	**12146**

From the data gathered it became apparent that underground mines accounted for 90% of all coal mining related fatalities. The major contributors to this data were Gas Ignition Explosions throughout history, which has accounted for some 147 incidents, but which have caused 9855 fatalities.

From the review it is apparent that in underground coal mines the main root cause of death is due to a fall in the roof or rib, once gas ignition explosions are discounted. One of the root causes of death is miners and other workers not always adhering to appropriate safe work procedures and entering unsupported ground.

It can also be said that the majority of fatalities in open cut/surface operations is due to unintended operation of equipment. This unintended operation may be due to a brake failure, loss of control of equipment, failure to isolate adequately or unexpected re energising of equipment.

As a general rule from analysing the recommendations made by inspectors, who investigated the fatalities, it is apparent that safe work procedures need to be reviewed by management and redeveloped. Design of equipment, especially underground has become an important factor in the coal mining industry and designers, manufacturers and mines should make considerable efforts with equipment to ensure that their equipment is fit for purpose. Another area which has come to light as an important area is the behaviour of workers, or culture within the workplace. A workplace which embraces a safe working culture is inherently a much safer place to work, and this should be adopted by all mines and regulatory agencies worldwide.

NON-COAL MINING FATALITIES

Resulting in only 10% of all mining fatalities, non-coal mining fatalities include all mines other than coal in underground and open cut/surface operations. The following table represents the breakdown of fatalities from countries across the world.

Table 6: Summary of International Mining Fatal Incidents from Non-Coal Mines.

	Underground	**Open Cut**	**Unknown**	**Total**
Australia	395	279	17	**691**
Canada	4	14	4	**22**
New Zealand	123	5	3	**131**

United Kingdom	41	15	2	**58**
United States of America	499	173	0	**672**
	1062	**486**	**26**	**1574**

The main cause of fatalities in the Non-Coal mine operations is Unintended Operation of Equipment, followed by Contact with Moving or Rotating Plant (Guarding/Access to Danger Zone). These two causes of fatality are classified as the main causes in Non-Coal Mining Open-cut Operations in general. When considering underground and open cut operations, the statistics alter somewhat.

In underground operations the main cause of death is a Fall of Roof/Sides/Highwall and accounts for approximately 34% of underground fatal incidents. Open cut mines are quite different in their main agent of fatality. The main cause of death in open cut operations is Unintended Operation of Equipment, which results in approximately 23% of fatalities.

Table 7: Summary of International Mining Fatal Incidents from Mines with Unknown Operation Type.

	Underground	**Open Cut**	**Unknown**	**Total**
Australia	9	6	32	**47**
Canada	0	0	8	**8**
New Zealand	12	5	9	**26**
Poland	0	29	0	**29**
	21	**40**	**49**	**110**

CONCLUSIONS AND RECCOMENDATION

1. Information that we can draw from this data is that mining fatalities, even with much improved safety systems, are still occurring regularly. Further and smarter use of available safety tools is needed to try and decrease the fatal injuries in the industry. The graphs and tables drawn from the data in this report are far from the only things which can be taken from the data. All future standard developments and overhauls should be based upon both fatality data and serious injury/incident data. This is because it gives a strong basis upon which standards can be improved.

2. Further and smarter use of the available tools in industry need to be made, to ensure a continued improvement in the mine safety record. There should also be a continued advancement in the industry of project such as this one to assist in delivering information to the people who need it. Even with the technical advances in equipment and safety systems, incidents of a very similar nature to past events still seem to occur regularly. As George Santayana once said, “those who do not learn from history are doomed to repeat it”.

3. The implementation of the hierarchy of control measures to control energy release is a key area in preventing incidents. Once an issue arises, the hierarchy should be followed starting with eliminating the issue, or substituting the issue. If this is not practical, installing engineering controls to protect the user is next followed by training and finally PPE to protect the user.

4. The number of catastrophic events shown within this database, some even within the last two years, should remind the mining industry that the danger of major incidents does not decrease just because it has not happened for some time. Continued effort is required in this area and this is the primary reason for regulating bodies, not as a policing measure, but in the prevention of catastrophic risk. Gas ignition explosions in coal mines far outweigh the dangers in terms of lives lost compared to single fatality incidents within this

database and that should remind the industry not to take their ‘eyes off the ball’ in terms of these ever present, potential major events.

5. From the data it is clear that the main issue arising from Open Cut mining operations is the absence, or a poor traffic management plan. Even in an Australian incident this year, it was thought to be the primary cause. Traffic management plans should be updated regularly to deal with any new equipment, changes in mining areas or problems which have been arising. Another area which came up as being of importance to focus on was highwall falls and isolation of both the area surrounding the base of highwalls where rockfall can occur and the top of highwalls, which can cause equipment to fall over the highwall. These types of incidents were higher than expected.

6. In underground mines, especially coal mines, the major issue which has arisen is falls of roof or sides. There should be in place strata control plans to control sides and roofs of mines. These should be updated regularly and reviewed when new equipment is introduced, new technology is introduced or a new mining area is entered. Another key area of importance in underground mines is around continuous miners, which have been shown to continue to be a dangerous area, with high numbers of fatal incidents.

7. OEM (Original Equipment Manufacturers) must be held to some degree of accountability for equipment which does not meet standards required in the mining industry. Obviously there are cases where a mine does not follow manufacturer guidelines or makes additions to equipment which override safety systems, however it should be placed upon OEM’s to keep up to date with incidents involving any of their equipment. This should then be followed by the update to safety systems to ensure they are constantly at the highest possible standard.

At the end of the day it is up to each individual user of this database, whether as a designer, OEM mine employee or a regulator to use the data effectively and arrive at any results and conclusions from the data analysis. Data may be interpreted differently by different people and hopefully this database is one of the sources of

information from which many industry improvements can be drawn. Equipment designers and manufacturers and suppliers should be using this information as the basis of their risk assessments to ensure that equipment is fit for purpose and any incident which compromises their safety systems should be modified and improved immediately.

I recommend that copies of both this report and the database, in multiple formats, be available for all DPI staff involved in mining safety related positions and also for all designers, manufacturers, OEM's, mine managers and mine safety officers. These are to be used at least for risk assessments as a preventative measure from incidents with equipment.

There is also a document available which outlines the basic functions of the excel spreadsheet database and how it is utilised. This is primarily for people who are unfamiliar with Microsoft Excel.

APPENDIX A – BREAKDOWN OF CATAGORIES

Mine Type:

• Open Cut	• Underground
• Unknown	

Operation Type:

• Coal	• Non-Coal
• Unknown	

Country:

• Australia	• Canada
• China	• France
• Germany	• India
• Japan	• New Zealand
• Poland	• Russia
• South Africa	• Ukraine
• United Kingdom	• United States
• Yugoslavia	• Zimbabwe

States:

• Alabama	• Alaska
• Arizona	• Arkansas
• Australian Capital Territory	• California
• Colorado	• Connecticut
• Delaware	• District of Colombia
• Florida	• Georgia
• Hawaii	• Idaho
• Illinois	• Indiana
• Iowa	• Kansas

• Kentucky	• Louisiana
• Maine	• Maryland
• Massachusetts	• Michigan
• Minnesota	• Mississippi
• Missouri	• Montana
• Nebraska	• Nevada
• New Hampshire	• New Jersey
• New Mexico	• New South Wales
• New York	• North Carolina
• North Dakota	• Northern Territory
• Ohio	• Oklahoma
• Oregon	• Pennsylvania
• Queensland	• Rhode Island
• South Australia	• South Carolina
• South Dakota	• Tasmania
• Tennessee	• Texas
• Utah	• Vermont
• Victoria	• Virginia
• Washington	• West Virginia
• Western Australia	• Wisconsin
• Wyoming	

Agent of Fatality:

• Asphyxiation	• Catastrophic Failure
• Contact with Moving or Rotating Plant (Guarding/Access to Danger Zone	• Drowning
• Electrocution	• Explosives
• Fall From Heights	• Fall of Roof/Sides/Highwall
• Fire	• Gas Ignition Explosion
• Inrush	• Other
• Other Explosion	• Outburst

• Pressure Vessel Explosion	• Tyre Explosion
• Uncontrolled Release of Energy	• Unintended Operation of Equipment
• Unknown	• Windblast

Equipment Involved:

• Access	• Belt Conveyor
• Bins	• Buildings/Structures
• Continuous Miner	• Cranes/Lifting
• Crushers	• Cutting and Welding
• Drill Rig	• Earthmoving Other
• Electrical Equipment	• Excavator/Dragline/Shovel
• Handheld Equipment	• Load Haul Dump – LHD
• Longwall	• Man Transport
• No Equipment	• Non-Belt Conveyor
• Other	• Process Plant
• Pumps/Compressors	• Shuttle Car
• Stockpiles	• Trains/Locos
• Truck	• Unknown
• Winders	• Workshop

Equipment Fit for Purpose Aspects:

• Blockage	• Brakes
• Guarding/Access/Egress	• Isolation
• None	• Pressure Intensification
• Remote Control	• Rope
• ROPS/FOPS	• Structural Failure
• Temporary Roof Support	• Tyres Rims
• Unknown	

Accident Location:

• Dam/River	• Mining Area
• Other	• Process Plant
• Road/Roadway	• Surface
• Unknown	• Workshop
• Yard	

Activity at Time of Accident:

• Loading/Unloading	• Maintenance
• Other	• Production
• Support Services	• Transport
• Unknown	

Management and Human Behaviour

• Competency Error	• Fitness For Work
• Misconduct	• No Direct or Obvious Human Error Involvement
• Procedural Error	• Unknown

APPENDIX B – ADDITIONAL DATABASE INFORMATION

Quality of Coverage in Database for the United Kingdom

Data from the United Kingdom is not comprehensive and included data is from selected data which could be sourced. Unlike Australian records and United States records, compete records for many periods of years could not be found for the United Kingdom, so the included data is only a sample of the fatalities which were able to be found.

All the fatality outlines from reports were not added to the database as there were insufficient detailed descriptions provided. Only fatalities which had detailed descriptions were added to the database from the United Kingdom data.

The List of UK Resources used

Library

Health and Safety Executive – Mines and Quarries 1976
Health and Safety Executive – Mines and Quarries 1977
Health and Safety Executive – Quarries 1978
Health and Safety Executive – Mines 1979
Health and Safety Executive – Quarries 1979
Health and Safety Executive – Mines 1980
Health and Safety Executive – Quarries 1980
Health and Safety Executive – Mines 1981
Health and Safety Executive – Quarries 1981
Health and Safety Executive – Mines 1982
Health and Safety Executive – Mines 1983
Health and Safety Executive – Quarries 1986
Health and Safety Executive – Mines 1986

Other sources used for the United Kingdom data are as follows

http://www.healeyhero.co.uk/rescue/pits/disaster.htm

Mining days in Abram. F. Ridyard. P37 (Leigh, 1972)

Disasters. Duckham. (p202-207)
Veritas' to the British Miner and General Newsman (11th October, 1862)

Quality of Coverage in Database for the United States

The United States has every fatal incident recorded between 1/1/1995 and 1/2/2008 posted on the database. There are also some extra fatalities which have been deemed as historically important. These range between 1907 and 1992.

APPENDIX C – ADDITIONAL DATABASES ACCESSED

Australian Databases:

- Mineral Council of Australia - http://www.minerals.org.au/downloads/pdf/safety_survey_report_jul01_mar02.pdf
- Safety Science Monitor Australia - http://www.ipso.asn.au/vol3/te2.pdf
- National Occupational Health and Safety Commission - http://www.nohsc.gov.au/PDF/Statistics/case_mining.pdf
- Mine Safe - http://www.minesafe.org/performance_data/fatalities.html
- The Lead Group Incorporated - http://www.lead.org.au/lanv7n1/L71-15.html
- Wardens Court of Queensland - http://www.warden.qld.gov.au/fatals.htm
- Work Cover - http://www.workcover.nsw.gov.au/

Indian Databases:

- Ministry of Coal and Mines – Department of Coal - http://www.coal.nic.in/point18.html
- Directorate General of Mines Safety - http://www.dgms.net/agenda.htm

International Databases:

- International Society of Mine Safety - http://ismsp.a2dinteractive.net/modules.php?name=Stories_Archive&sa=show_all