Introduction to Mining Occupational Health and Safety Management in Australia

David Cliff

March 2014
The Sustainable Minerals Institute
The University Of Queensland
An Overview
The University of Queensland
The Fast Facts

Our institution
• Four campuses
• Six faculties
• Eight research institutes
• More than 400 undergraduate and postgraduate degree programs
• AU $1.64 billion total operating revenue
• Research commercialisation

Our People
• 45,548 students
• 11,398 international students from 130 countries
• 12,268 postgraduate students
• 4,593 research higher degree students
• 7,453 staff
• 200,000+ Alumni in 160 countries
Mining and Metals at The University of Queensland

• Sustainable Minerals Institute (SMI)
• Faculty of Engineering Information Technology and Architecture
  • School of Chemical and Metallurgical Engineering
  • School of Mechanical and Mining Engineering
  • Civil and Environmental Engineering
• Faculty of Science
  • School of Earth Sciences
  • School of Biological Sciences
• Faculty of Business, Economics and Law
  • School of Business
Sustainable Minerals Institute
Research, Education and Consulting for the Resources Sector

MISSION

To be a world leader in providing knowledge-based solutions to the sustainability challenges of the global resources industry

VISION

To create the capability for the minerals industry to transition to sustainability
What We Do...

COLLABORATION & PROJECT MANAGEMENT

Environment

Coal Seam Gas

BRC

SMI

CSR

Water Management

Social Responsibility
The Sustainability Maturity Journey

**SMI** Sustainable Minerals Institute

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**Sustainable**

**Effective**

**Efficient**

**Only Revenue Maximising**

**BENEFITS**

**MATURITY**

**DEVELOP, TEST AND DEPLOY** leading edge technology and processes to deliver industry capability to meet their efficiency goals.

**INTEGRATE** disciplinary capability (engineering - science - social science) and the operating environment (life cycle, value chain and mining regions).

Through the NextMine™ and NextWorkforce™ initiative SMI will lead a transition from efficiency to effectiveness and demonstrate how industry and community development constraints can be overcome.

SMI uses efficient methods to ADDRESS landscape and community legacies associated with 'Only Revenue Maximising' focused mining activities of the past.

**DEFINE** sustainability and make it implementable and measurable in an industrial context, positioning the mining and minerals industry as a lead case for global industry.

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**The University of Queensland**

**Australia**
The key elements of a high-functioning OH and S management system
(The Report of the Independent Taskforce on Workplace Health and Safety (NZ) 2013)

- Good workable law
- An effective primary regulatory agency
- Strong, visible leadership
- A robust level of capacity and capability – agency and workplace
- Tripartism throughout the system
- Genuine and effective worker participation
- Incentives that are effective levers for good practice
The key elements of a high-functioning OH and S management system (cont.)

- High quality data
- Occupational Health is taken seriously
- SME’s have easy access to useful information
- High-risk population groups are targeted effectively
- Major hazards are effectively regulated
- A national culture that is more risk aware
Australia is a federation of states
<table>
<thead>
<tr>
<th>Mineral</th>
<th>Unit</th>
<th>2010</th>
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<tbody>
<tr>
<td>Bauxite</td>
<td>Mt</td>
<td>69</td>
</tr>
<tr>
<td>Black Coal</td>
<td>Mt</td>
<td>450</td>
</tr>
<tr>
<td>Copper</td>
<td>Mt</td>
<td>870</td>
</tr>
<tr>
<td>Diamonds</td>
<td>'000 ct</td>
<td>10000</td>
</tr>
<tr>
<td>Gold</td>
<td>t</td>
<td>260</td>
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<tr>
<td>Iron Ore</td>
<td>Mt</td>
<td>434</td>
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<tr>
<td>Lead</td>
<td>kt</td>
<td>711</td>
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<tr>
<td>Manganese</td>
<td>Mt</td>
<td>65</td>
</tr>
<tr>
<td>Nickel</td>
<td>kt</td>
<td>170</td>
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<td>Crude oil and condensate</td>
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<td>27000</td>
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<td>LPG (naturally occurring)</td>
<td>ML</td>
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<td>Natural gas</td>
<td>Mm$^3$</td>
<td>45000</td>
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<td>Silver</td>
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<tr>
<td>Tin</td>
<td>kt</td>
<td>19</td>
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<td>Uranium oxide (U$_3$O$_8$)</td>
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<td>7200</td>
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<tr>
<td>Zinc</td>
<td>kt</td>
<td>1480</td>
</tr>
<tr>
<td>Zircon concentrates</td>
<td>kt</td>
<td>540</td>
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The journey in Australia

- Pre 1994 – Australian legislation was prescriptive – compliance – rule based
- Companies were judged to be safe if they met the standards set by the legislation
The journey in Australia

- Post 1994 a reform process
- Duty of Care – Roben’s style has begun to be introduced
- Risk Management and Safety Management Systems now underpin the legislation
- Mines are deemed to be safe if they can demonstrate that they have a safe workplace
- Regulations are being developed to encourage management of OHS by mines
Key principles

- Duty of care – mutual obligation
- Risk Management – reduce risks to as low as reasonably possible
- Workforce participation – consultation and representation
- Information and communication
- Training – competency based
- Strong, experienced and respected independent mines inspectorate
Legislative hierarchy

• Act
• Regulations
  – Prescriptive
  – enabling
• Advisory standards/codes of practice
  – May or may not be referred to in legislation
• Australian/International standards
  – May or may not be referred to in legislation
• Other standards or guidelines eg ASCC
• Guidance notes
Compliance vs management

SAFETY PERFORMANCE

LEGISLATION
Duty of Care

• Employer must, as far as practicable, provide a work environment in which employees are not exposed to hazards and provide information, training and supervision

• Employees must take reasonable care of their own safety and health and that of others at work
Duty of care

- Shared between employers and employees.
- Primary responsibility rests with employer.
- Duty may be higher to inexperienced.
- Duty is higher in hazardous environment.
- Encourages management of OH and S rather than compliance with regulation.
Duty of care obligations

- The holder of a mining lease
- The operator of a coal mine
- The senior site executive
- A contractor
- A designer, manufacturer, importer or supplier of plant
- An erector or installer of plant
- A manufacturer, importer or supplier of substances for use at a coal mine
- A person who supplies services to a coal mine
Key elements of Qld Coal Mines Safety and Health Act

Division 2 Cooperation
Cooperation is an important strategy in achieving the object so the Act and is achieved:

• at an industry level by:
  – the establishment of the coal mining safety and health advisory council; and
  – the appointment of industry safety and health representatives; and

• at coal mine level by:
  – the election of site safety and health representatives; and
  – the process of involving coal mine workers in the management of risk.
Safety and Health Management System

• Cornerstone of legislation

• Basic elements are:
  – Risk identification and assessment
  – Hazard analysis
  – Hazard management and control
  – Reporting and recording relevant safety and health information and data
OHSMS – AS4804 and AS4801

- Management Review
- OHS Policy
- Planning
- Implementation
- Measurement and Evaluation
Multiple fatalities in Australian Underground Coal Mines since 1970

• 1996 – Gretley - inundation – 4 dead
• 1994 – Moura No.2 – methane explosion - 11 dead
• 1991 – South Bulli – outburst – 3 dead
• 1986 – Moura No. 4 – methane explosion – 12 dead
• 1975 – Kianga – methane explosion – 17 dead
• 1972 – Box Flat – methane explosion – 13 dead
Underground Metalliferous - major incidents

• Bronzewing – June 2000 – inundation – 3 dead
• North Parkes – 24 November 1999 – airblast – 4 dead
• Beaconsfield 25 April 2006 – rockfall – 1 dead two trapped
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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<td>0</td>
<td>4</td>
<td>0</td>
<td>3 (2)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>(1)</td>
<td></td>
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<tr>
<td>Underground coal</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Open cut metalliferous</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>9 (7)</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
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<tr>
<td>Underground metalliferous</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>4</td>
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<td>Extractive industries</td>
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<td>3</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>4</td>
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<td>Smelting/Refining</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
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<td>Exploration</td>
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<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
<td>3</td>
<td>9 (11)</td>
<td>9</td>
<td>20 (17)</td>
<td>4</td>
<td>14</td>
<td>11</td>
<td>10</td>
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Fatality types

Fatalities 2000-08

<table>
<thead>
<tr>
<th>Fatality Type</th>
<th>Number</th>
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<tbody>
<tr>
<td>Crush</td>
<td>16</td>
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<tr>
<td>Electrical</td>
<td>4</td>
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<tr>
<td>Explosives</td>
<td>1</td>
</tr>
<tr>
<td>Fall</td>
<td>9</td>
</tr>
<tr>
<td>Fire</td>
<td>7</td>
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<tr>
<td>Hit by</td>
<td>10</td>
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<tr>
<td>Other</td>
<td>4</td>
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<tr>
<td>Rock Fall</td>
<td>24</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
</tr>
<tr>
<td>Vehicle</td>
<td>23</td>
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</table>
Haul Truck Accident
Heat exposure
Haul road overwatered
Person crushed by mobile plant

Injured person had a conversation with the LHD driver and then was walking past the machine. LHD driver articulated the LHD in the process of negotiating a right hand corner.
Incident causality
(Latent Pathogen Model by James Reason)
Types of Human Error

- **Slips / lapses**
  - Lapses of attention; inadvertent omissions

- **Mistakes**
  - Lack of knowledge to select the appropriate plan of action

- **Violations**
  - Deviation from understood and accepted normal practice for whatever reason
  - Cultural or Deviant

James Reason
Visibility

Grey areas indicate where operator cannot see a 6 ft tall person.
The Ideal Miner?
The Basic Risk Management System

1. Identify the Hazards
2. Assess the Risks
3. Decide to Mitigate
4. Decide to Eliminate
5. Decide to Tolerate
6. Take Action
7. Monitor for Change
8. Monitor Performance
What is **Risk**?

**PROBABILITY**
that an event will occur,
and
**MAXIMUM REASONABLE CONSEQUENCES**
should it occur
### Example Risk Ranking Table

<table>
<thead>
<tr>
<th>Likelihood of Unwanted Event (Probability)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>9</td>
<td>13</td>
<td>17</td>
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<td>4</td>
<td>10</td>
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<td>18</td>
<td>21</td>
<td>23</td>
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<tr>
<td>5</td>
<td>15</td>
<td>19</td>
<td>22</td>
<td>24</td>
<td>25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Severity of Unwanted Outcome (Consequence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
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<tr>
<td>---</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>
BOWTIE ANALYSIS MODEL

Design criteria

Exposure to Noise

Control Measures

Recovery Measures

Emission monitoring.
Insulation effectiveness

Audiometry
Exposure Monitoring
% wearing PPE

Consequences

NIHL
“Layered” Risk Assessment Differences

Risk Profile

MAJOR HAZARD / FULL SITE RISK ASSESSMENT

PROJECT / CHANGE / ISSUE RISK ASSESSMENT

REPETITIVE /SCHEDULED TASK SAFE-WORK-METHOD DESIGN

WORK TEAM TASK ASSIGNMENT RISK ASSESSMENT

INFORMAL, “FACE” RISK ASSESSMENT

1. Prioritize hazards on “Estimated” Risk
   - (Likelihood x Severity of Consequence)
2. Nominating required Project/Design/Change/Issue Risk Assessments and Managerial Systems compliances

1. Prioritize hazards on “Estimated” Risk
   - (Likelihood x Severity of Consequence)
2. Identify ‘Control’ effectiveness for each layer of protection
3. Judge Control Adequacy on the chance of failure-on-demand of the combined layers in control & recovery

1. Prioritize hazards on “Estimated” Severity of Harm
2. Zero Harm = No Priority
3. If harm is possible; then identify protection action / controls

1. Confirm workplace energies are under-control
2. Choose work method to suit conditions;
3. Do not Start or Continue tasks unless controls are confirmed adequate

15/09/2010

Minerals Industry Safety & Health Centre The University of Queensland; Sustainable Minerals Institute
Roles of Inspectors and Inspection Officers

• to enforce the act and regulation - the traditional role
• to monitor safety and health performance at coal mines
• to inspect and audit coal mines to assess whether the level of risk to persons is at an acceptable level.
• To provide advice and assistance - this is a role that many inspectors find challenging as it exposes their knowledge and skills and requires them to maintain and expand their skills base
Mines Inspector qualifications and experience

- Sector specific (coal, metalliferous….)
- Ex mine managers – very experienced in mining
- Mine manager certificate of competency
- Trained in diploma of workplace inspection
  - Compliance inspection
  - Investigations for Coronial Inquests
  - Managing Major incidents and emergencies
  - Communication Skills including managing conflict
  - Risk Management and Resource Allocation
  - Public Sector Legislation
- Sector specific competency eg ventilation, gas management
• **Specialist inspectors**
  – Electrical, mechanical, geotechnical
  – Experienced at a senior level on a mine site
  – Tertiary qualifications in specialist area

• **Trained in diploma of workplace inspection**
  – Compliance inspection
  – Investigations for Coronial Inquests
  – Managing Major incidents and emergencies
  – Communication Skills including managing conflict
  – Risk Management and Resource Allocation
  – Public Sector Legislation
Enforcement Hierarchy
- **E**: extreme risk – **Directives** to suspend or stop activity or part of operation
- **H**: high risk – **Directives** for immediate action to address activity and or system
- **M**: moderate risk – **SCP** for action to address activity or system
- **L**: low risk – **SCP** or **recommendation** depending on the circumstances

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Consequences or Potential Impact</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Insignificant 1</td>
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<tr>
<td>A (Almost certain)</td>
<td>L</td>
</tr>
<tr>
<td>B (Likely)</td>
<td>L</td>
</tr>
<tr>
<td>C (Possible)</td>
<td>L</td>
</tr>
<tr>
<td>D (Unlikely)</td>
<td>L</td>
</tr>
<tr>
<td>E (Rare)</td>
<td>L</td>
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</table>
Types of Directives

- **Directives MQSHA (CMSHA):**
  - S 161 (S 164) – to ensure worker competent
  - S 162 (S165) – to carry out test
  - S163 (S166) – to reduce risk
  - S 164 (S167) – to suspend operations for unacceptable level of risk
  - S 165 (S168) – to review safety and health management system (and principal hazard management plans)
  - S 166 (S169) – to suspend operations for ineffective safety and health management system
  - S167 (S170) – to isolate site
  - S 168 (S171) – relating to a separate part of the mine
  - S 169 (S172) – to provide independent engineering study
OHSMS – AS4804 and AS4801

- Management Review
- Measurement and Evaluation
- Implementation
- OHS Policy
- Planning

Diagram: The cycle of OHSMS includes Management Review leading to OHS Policy, which then leads to Planning, which in turn leads to Implementation, and finally to Measurement and Evaluation, completing the cycle.
Key elements of Qld Coal Mines Safety and Health Regulations

- Chapter 4 Underground mines
- Part 1 Preliminary
- Part 2 General
  - Principal Hazard Management Plans covering:
    - Emergency response
    - Gas management
    - Methane drainage
    - Mine ventilation
    - Spontaneous combustion
    - Strata control
  - May include other areas if risk assessment identifies unacceptable risk eg:
    - Outburst
    - Inundation
Risk Management Information Systems

Minerals Industry Health & Safety Resources

The Minerals Industry Safety & Health Centre, supported by ACARP and industry funding, has developed a range of information resources designed to assist the management of safety & health risks. The MINGATE links below provide free access to comprehensive health and safety information about key issues that concern the minerals industry.

MINGATE: Minerals Industry, Risk Management Gateway

MINGATE has been available online since 2004. It allows users to quickly find what they are looking for by cross referencing Subjects, Topics and Resources.

MINGATE Topics: Earth Moving Equipment, Safety Round Table

MINGATE provides access to information about the MINGATE Design Philosophies for exploration and mining equipment design.

Typegate: Type & Mine Risk Management Decision Support Tool

TYPEgate is a world leading, a searchable Causal Factors Database which provides the mining industry with unique, up-to-date and complete sources of information about earthmoving type & from safety and maintenance improvements.

CASEgate: Relational Risk Management Decision Support Tool

CASEgate is designed to assist the mining industry, including equipment manufacturers, and service providers, in developing more effective decision strategies.

COMPLIANCegate: Compliance Support (Australian focus)

COMPLIANCegate conveniently classifies and cross references mining safety and health compliance documentation so you can quickly and easily get the latest assessments and regulatory information.

SMI Sustainable Minerals Institute
PIKE RIVER MINE DISASTER

29 men died because:
- no one properly carried out their duty of care or took responsibility for their own safety and that of others
- The risk management was inadequate
- The OHSMS was inadequate
- Warnings were ignored
- The government inspection regime was inadequate – poorly trained, inadequately resourced