Learning from the past: Pattern causes of death and disaster in extractive industries

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Content

• Background and methods
• Ten pattern causes
• Some evidence on feedback/oversight
• Observations and Policy Implications
• Some conclusions
### Summary of Mine Incidents Examined & Referred To

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Incident Type</th>
<th>Fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 September 1975</td>
<td>Kianga Mine, QLD</td>
<td>Explosion</td>
<td>13</td>
</tr>
<tr>
<td>16 July 1986</td>
<td>Moura No.4, QLD</td>
<td>Explosion</td>
<td>12</td>
</tr>
<tr>
<td>8 July 1994</td>
<td>Moura No.2, QLD</td>
<td>Explosion</td>
<td>11</td>
</tr>
<tr>
<td>14 November 1996</td>
<td>Gretley Col., NSW</td>
<td>Inrush</td>
<td>4</td>
</tr>
<tr>
<td>30 October 2000</td>
<td>Cornwall Col. Tas</td>
<td>Rockfall</td>
<td>1</td>
</tr>
<tr>
<td>6 June 2001</td>
<td>Renison Mine, TAS</td>
<td>Rockfall</td>
<td>2</td>
</tr>
<tr>
<td>5 May 2003</td>
<td>Renison Mine, Tas</td>
<td>Rockfall</td>
<td>1</td>
</tr>
<tr>
<td>19 May 2004</td>
<td>BHP Newman WA</td>
<td>Hit by machinery</td>
<td>1</td>
</tr>
<tr>
<td>25 April 2006</td>
<td>Beaconsfield, Tas</td>
<td>Rock Fall</td>
<td>1 (2 trapped)</td>
</tr>
<tr>
<td>19 May 1992</td>
<td>Westray, Canada</td>
<td>Explosion</td>
<td>26</td>
</tr>
<tr>
<td>19 November 2010</td>
<td>Pike River, NZ</td>
<td>Explosion</td>
<td>27</td>
</tr>
<tr>
<td>25 September 2011</td>
<td>Gleiision Col, UK</td>
<td>Inrush</td>
<td>4</td>
</tr>
<tr>
<td>DATE</td>
<td>LOCATION</td>
<td>INCIDENT TYPE</td>
<td>FATALITIES</td>
</tr>
<tr>
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</tr>
<tr>
<td>7 DECEMBER 1992</td>
<td>NO.3 MINE, VI USA</td>
<td>EXPLOSION</td>
<td>8</td>
</tr>
<tr>
<td>23 SEPTEMBER 2001</td>
<td>NO.5 JWR AL USA</td>
<td>EXPLOSION</td>
<td>13</td>
</tr>
<tr>
<td>2 JANUARY 2006</td>
<td>SAGO MINE WV USA</td>
<td>EXPLOSION</td>
<td>12</td>
</tr>
<tr>
<td>20 MAY 2006</td>
<td>DARBY NO.5 KY USA</td>
<td>EXPLOSION</td>
<td>5</td>
</tr>
<tr>
<td>6 AUGUST 2007</td>
<td>CRANDALL UTAH US</td>
<td>FALL OF RIB/FACE</td>
<td>6</td>
</tr>
<tr>
<td>5 APRIL 2010</td>
<td>UBB MINE WV USA</td>
<td>EXPLOSION</td>
<td>29</td>
</tr>
</tbody>
</table>
Presentation draws on review of official investigations into 24 fatal incidents and disasters in mine in 5 countries (Australia, New Zealand, USA, UK and Canada) 1990 and 2011. Are the repeat or pattern causes underpinning these events?

Five countries with similar regulatory regimes and governance facilitate generalisation as did the number of incidents examined.

15 involved 3 or more deaths while 9 single fatalities (includes 4 fatal mine incidents in Tasmania). Do the causes vary between multiple and single fatality incidents?

Most multiple fatality incidents occurred in coal mines (86%) and each incident also killed more on average (11 per incident compared to 6 in metalliferous mines)

Why look at failures for patterns?

• Failure can be as instructive as success
• Examining series of incidents identifies recurring causes, why systems fail & how to remedy
• Strategic decision making needs to draw on past while recognising risk of misinterpretation & change
• Focus on mining but same approach could be used regarding other industries and types of incidents
• Identified 10 causal pathways to fatal incidents (at least 3 present in virtually all while majority had 5 or more – some had all 10)
• More thorough the investigation the more pattern causes identified
Pathway 1: Design, engineering & maintenance flaws

How and some incidents where contributed (some examples)

- Failure to provide/maintain plant etc (eg Westray ventilation/monitoring/roof bolting)
- Inadequately planned mining methods & failure to revise (Westray, Crandall Canyon)
- Flawed/misused maps of workings (Gretley)
- Seal design/flaws (Sago & Moura No.2)
- Hydro mining and main ventilator UG (Pike River)
- Inadequate ground support regime (Beaconsfield)
- Poor coal dust control measures (Upper Big Branch)
Pathway 2: Failure to heed clear warning signals

How and some incidents where contributed

• Failure to respond to trends in atmospheric pressure & methane levels (Westray, Pike River)
• Failure to respond to or analyse rockfalls (Cornwall, Renison & Beaconsfield)
• Failure to respond to prior outbursts (Crandall Canyon)
• Failure to adequately respond to evidence of heating (Moura No.2 - note too two prior disasters)
• Evidence of abnormal water prior to inrush (Gretley)
Pathway 3: Flaws in risk assessment

How and some incidents where contributed

- Failure to assess risk of inrush (Gretley)
- Failure to properly assess risks prior to authorising entry (Jim Walter Resources/JWR)
- Failure to do risk assessment following coal outbursts (Crandall Canyon)
- Failure to undertake comprehensive risk assessment after major rockfall (Beaconsfield/BG)
- Failure to risk assess hydro mining or UG main ventilator (Pike River)
Pathway 4: Flaws in management systems

How and some incidents where contributed

• Poor system structures/communication & over-focus on behaviour or minor safety issues (JWR, BG)
• Inadequate training/procedures (Sago & Darby No.1)
• Failure to maintain safety critical systems – rock dusting, ventilation, equipment – UBB & Pike R)
• Poor management of contractors/work re-organisation (Renison, BHPB, Pike River)
• Poor hazard/risk management systems & worker feedback mechanisms (BHPB)
Pathway 5: Flaws in system auditing

How and some incidents where contributed

• Failure to audit critical safety processes (eg Moura No.2 management of spontaneous combustion)
• Failure to adopt audit findings (BG)
• No proper OHS audit (Pike River)
Pathway 6: Economic/reward pressures compromising safety

How and some incidents where contributed

- Production pressure/cost cutting compromising safe work practices (Westray, UBB, Pike River) or use of consultants/in-house technical expertise (Renison)
- Poor financial state of mine putting miners ‘under the pump’ (Westray, Renison)
- Incentive pay systems encouraging unsafe practices (Westray & Pike River)
Pathway 7: Failures in regulatory oversight

How and some incidents where contributed

- Insufficient/inadequately trained or supervised inspectors (3 Tas incidents, Sago, Pike River)
- Poor inspection procedures (Crandall, Darby No.1, JWR) including prior notice (UBB)
- Inadequate/poorly targeted enforcement (Westray, Gretley, Sago, UBB, Pike River)
- Flaws in Legislation - standards, reporting requirements, sanctions, worker rights (3 Tas, Pike River, UBB & other US disasters)
Pathway 8: Worker, consultant & supervisor concerns prior to incident

How and some incidents where contributed

- Evidence of significant level of serious concerns (Cornwall, BG, UBB)
- Worker/supervisors raised concerns but were ignored (Cornwall, BG)
- Supervisor and consultant concerns at Pike River (eg Hydro mining)

Note: this matter seldom seems to be explored in the course of most investigations (BG & UBB exceptional in that interviewed large numbers of miners and even family members)
Pathway 9: Poor management/worker communication/trust

How and some incidents where contributed

- Prolonged/bitter struggle over unionisation (Westray, BG) or non-union mine (UBB)
- Inadequate input mechanisms (Ctees & HSRs) & poor response to workers raising safety issues (BG, BHPB)
- Poor management communication processes (Moura No.2)
- Poor management response to worker, supervisor and union concerns (Pike River)
Pathway 10: Flaws in emergency procedures/resources

How and some incidents where contributed

• Flaws in emergency procedures, maps or training (Darby No.1, Sago)

• Poor safety management makes rescue more dangerous (Crandall, BG)

• Poor inspectorate/Mine Rescue Brigade rescue procedures or resources (Moura No.2, Sago, Crandall)

• No second egress (Pike River)
2014 Queensland ISHR/SSHR study

- Examined 1165 MI, ISHR & SSHR inspection reports for 19 mines (7 ug & 12 o/c) 1984-2013 (75% since 2000)
- Queensland electronic records of all inspections/follow-ups etc kept and exchanged – this is very important (should occur elsewhere if doesn’t now)
- MI 605 (52%); ISHR 473 (41%); SSHR 50 (4%)
- Also interviewed ISHRs & SSHRs at 13 of mines, and senior mines inspector
- Both MI & ISHR/SSHR inspections focused on serious hazards (ie fatality risks)
- Over 90% of ISHR/SSHR reports dealt with at least one fatality risk (many more than one)
- Also strong emphasis on HPIs and incident investigation
ISHR/SSHR study continued

- No evidence ISHR/SSHR reports dealt with anything but safety & sparing use of suspension powers (24 SSHR reports & 3 SSHR – all but 1 related to fatal risks/exception was bullying case)

- 54% of ISHR reports examined documents as well as physical (MI 50% and SSHR around 20%)

- Evidence of system corrosion at some mines & suspensions to prevent serious incidents – in some cases management suspended operations, other cases MI,ISHR,SSHR

- Overall good relationship between MI & SSHR & ISHR/strong complementary roles (little disagreement re suspension)

- Some issues re SSHR presence & management turnover
**Policy implications**

- Pattern flaws provide reference point for
  - Assessing regulation/identifying gaps
  - Informing inspection practices & incident investigation (eg Pike River, Gleision colliery)
- Evaluating regulatory regimes
  - Guidance on & auditing of systems and risk assessment
  - Prescription re well known hazards (systems/risk management & prescription balance)
  - Vigorous reporting of any safety critical deviations
  - Strengthening auditing requirements
  - Strengthening regulatory oversight
  - Providing/facilitating meaningful worker input
Concluding observations

- These pattern causes help to explain fatal incidents in mines and other high hazard workplaces (like quarries) & focusing on them would minimise fatalities
- Safety ‘culture’ was not a pattern cause rather symptom of failure in OHS management regime and priorities
- Systems as hierarchies of control that corrode over time & better suited to routine risk?
- Pattern causes apply to both single fatalities and multiple fatalities (both low frequency/high impact events)
- Changes to work organisation like subcontracting can weaken as can frequent changes to key management positions (corporate policies can exacerbate)
- Clear lessons in terms regulation but battle to implement these in wealthy democratic countries & largely ignored in newly industrialising countries
Concluding observations cont.

- Mining has over 200 years experience to learn from and help other high hazard industries.
- Must ask why lessons from past failures lost/forgotten or not kept?
- Qld and NSW learned important lessons from 1990s disasters and since regulatory reforms no disasters notwithstanding major industry expansion & adjudged world’s best practice regulation by Pike River Royal Commission
- Reforms recognised number of pattern causes including the need for comprehensive and rigorously audited management of all major hazards, clear requirements re known hazards/controls, well-resourced proactive inspectorate, and strong worker input.
- Important package as it is mutually reinforcing with multiple feedback loops (internal company, inspectors, safety reps/union) to identify failures and ensure constructive dialogue (potential for different viewpoints is critical).
Concluding observations cont.

- Need to remain vigilant about sustaining these key elements and the ever-present risk of corrosion of even robust regimes (recent black lung cases?)

- Actually entering dangerous period
  - Downturn/job insecurity and industry/corporate restructuring
  - Length of time since last disaster
  - Complacency/over-confidence that paperwork systems reflect actual practices
  - Increased use of subcontractors requires ongoing oversight
  - Must ensure key roles and ‘eyes’ get trained and encouraged to speak out/identify problems
  - Queensland study found disturbing number of incidents where down to very last line of defence ie late intervention by management, MI, ISHR or SSHR.

- Need reactivated attention from all or history will repeat – a degree of unease is essential
References

• M. Quinlan (2014), *Ten Pathways to Death and Disaster: Learning from fatal incidents in mines and other high hazard workplaces*, Federation Press, Sydney.
