

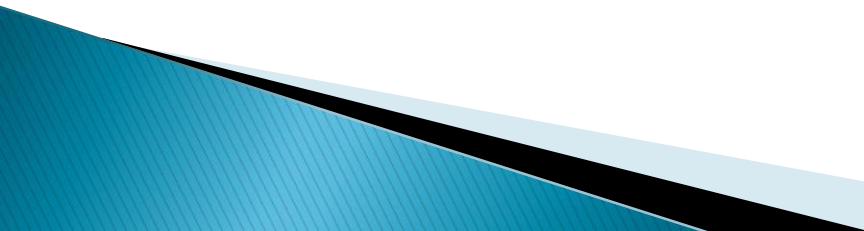
Learning from failure: 10 Pathways to Death and Disaster

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Michael Quinlan School of Management, UNSW and
Business School Middlesex University London

Learning from failure: Contents

Content

- ▶ Why study failure and human dimensions of harm
 - ▶ Ten pattern causes of fatal incidents at work
 - ▶ Observations and lessons/remedies
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Why look for failure patterns?

- ▶ Failure can be as instructive as success, especially in case of low frequency/high impact events where
 - Statistical records like workers' compensation, lost day and medical treatment injuries of little value
 - Need to use different indices, KPIs and remedies
- ▶ Examining series of incidents identifies recurring causes, why systems fail & how to remedy
 - Managing risk is about identifying patterns (causes and effects) and examining series of failures is arguably best way to identify patterns
- ▶ Strategic decision making needs to draw on past while recognising risk of misinterpretation & change



The Human cost of failure Sandra Welsh and her daughter Jenna leave the Burnie Magistrate's Court following proceedings relating to the Jan 2014 death of Michael Welsh asphyxiated in a mud-rush at CMT now subject to coronial inquest with prosecution still possible

Some evidence on the human cost of failure

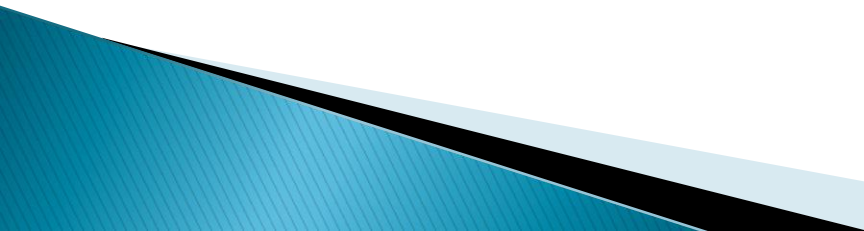
- 2007–18 study – impact of workplace death
- interviews institutional representatives/families & global survey (respondents 62% Australian, Canada 17%, USA 16%, UK 5%/ respondents 90% female/fatalities 90% male)
- Survey findings 61% experiencing (PTSD), 44% (MDD) and 42% (PGD)
- Also significant effects on children, financial effects (especially self-employed), key role of self-help groups
- What families want regarding prevention
 - Clear and timely information of how/why death occurred
 - Deceased not dehumanised by legal processes
 - Identification of responsibility and timely prosecution if breach with significant penalties that will act as deterrent
 - Remedial measures so other families spared similar tragedy

Background and Methods

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

- ▶ Detailed examination of 24 fatal incidents in coal & Metalliferous mines in 5 countries (Australia, New Zealand, USA, UK and Canada) 1990 and 2011. 15 involved 3 or more deaths while 9 single fatalities. Identified 10 repeat/pattern causes.
- ▶ Examined over 30 multiple fatality incidents in 10 countries in other high hazard workplaces (chemical plants, refineries, oil rigs, aviation, shipping and road transport). Same pattern causes.
- ▶ 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
- ▶ This talk includes several events not in book. Selection random, focusing on pattern causes not blame.

Ten pattern causes

- ▶ Design, engineering and maintenance flaws
 - ▶ Failure to heed clear warning signals
 - ▶ Flaws in risk assessment
 - ▶ Flaws in management systems and changes to work organisation
 - ▶ Flaws in system auditing
 - ▶ Economic/production and rewards pressures compromising safety
 - ▶ Failures in regulatory oversight
 - ▶ Supervisor and worker expressed concerns prior to the incident
 - ▶ Poor management/worker communication/trust
 - ▶ Flaws in emergency procedures and resources
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Incidents referred to

Date	Location	Incident type	Fatalities
24 November 1999	North Parkes mine (NSW)	Air blast	4
30 October 2000	Cornwall Colliery (Tas.)	Rock fall	1
6 June 2001 & 5 May 2003	Renison (Tas.)	Rock fall	2/1
25 April 2006	Beaconsfield (BGM) Tas.	Rock fall	1
19 March 2009	BHP Newman WA	Hit by machinery	1
19 November 2010	Pike River mine (New Zealand)	Explosion/fire	29
18 February 2009	Ravensworth open cut	Reject bin door failure	1
30 November 2013	Ravensworth open cut	Heavy/light vehicle collision	1



Pike River Mine Disaster 19 November 2010 >>

Pathway 1: Design, engineering & maintenance flaws

- ▶ **Pike River (2010)**
 - Hydro mining
 - Locating main ventilator UG
- ▶ **North Parkes Mine (1999)**
 - Height of void and location of bulkhead to protect against air blast inadequate (and management should have known this)
- ▶ **Beaconsfield (2006)**
 - Inadequate ground support/roof bolts (2.3m friction bolts) at Beaconsfield Gold Mine
- ▶ **Ravensworth**
 - 2009 Software controlling automated opening reject bin door failure
 - 2013 Traffic management plan deficiencies (windrow heights, intersection design, grades and crossfalls contribute to water ponding)

Pathway 2: Failure to heed clear warning signals

▶ **Pike River**

- Board informed of safety concerns prior to incident
- Notifiable methane levels exceeded

▶ **Cornwall, Renison and Beaconsfield**

- Failure to respond to or analyse rockfalls
- At BGM concerning pattern of falls including area of fatal fall (reports identified inadequate ground support)

▶ **Gretley**

- Evidence of abnormal water prior to inrush

▶ **Ravensworth**

- 2009 Inspector noted 5 prior incidents (unplanned movements of door)
- 2013 Investigation identified 11 prior incidents (near misses/minor collisions) 19/1/2011 – 17/10/2013 & November presentation on heavy vehicle interactions (emphasised behaviour/administrative controls)

Pathway 3: Flaws in risk assessment

Pike River

- ▶ Failure to risk assess hydro mining or UG main ventilator (Pike River)

North Parkes

- ▶ Failure to assess risk of void or bulkhead barrier and loss/absence of qualified experts to manage this

Gretley

- ▶ Failure to assess risk of inrush

BGM

- ▶ Failure to undertake comprehensive risk assessment including existing controls/ground support after major rockfall in 2005

Ravensthorpe

- ▶ 2013 prior risk assessment identified collision risk due to communication & vision issue (some ref to wet conditions but not night combination)/perception error re building lights and pond (Inspector identified number of gaps in risk assessment)

Pathway 4: Flaws in management systems

Pike River

- ▶ Failure to maintain safety critical systems –rock dusting, ventilation, equipment
- ▶ Poor management of contractors

Renison, North Parkes

- ▶ Poor management of contractors (eg Renison, North Parkes Mine)

Ravensworth

- ▶ 2009 Error in SOP undetected, safety critical information not passed on to software designer (Judge) .
- ▶ 2013 both drivers hired in last 12 months and undergoing competency training. Heavy Vehicle driver just assessed as competent on bigger Caterpillar 793D haul dump truck (first shift at night after rain).

Pathway 5: Flaws in system auditing

Pike River

- ▶ No proper OHS audit (Pike River) although concerns raised with Board

BGM

- ▶ Failure to adopt some audit findings

North Parkes Mines

- ▶ Inadequate monitoring of caving

Ravensworth

- ▶ 2013 did auditing but question of considering higher order controls (eg vehicle separation)

Pathway 6: Economic/reward pressures compromising safety

Pike River

- ▶ Production pressures/financial difficulties
- ▶ Time sensitive bonus encouraged unsafe practices

North Parkes Mine

- ▶ Production rate taking precedence over safety, caving problem & air blast risk well known)

Renison

- ▶ Poor financial state of mine leading to outsourcing technical expertise and put miners 'under the pump'

Ravensworth

- ▶ 2013 inspector noted mine identified challenge posed to resources, training, systems & processes to achieve increased production goals (company 2013 annual report identified mine's production contribution)

Pathway 7: Failures in regulatory oversight

Pike River

- ▶ Legislation inadequate re HPIs, systems–requirements (including principal risk management and TARPS), specification standards on known hazards, worker involvement, enforcement and penalties
- ▶ Inspectors lacked expertise/resources and poor strategic use (also no Chief Mines Inspector)
- ▶ Post–Pike changes addressed these & most other pattern failures

North Parkes

- ▶ Inspectorate inadequate knowledge of block caving

Renison, Cornwall and BGM

- ▶ Flaws in Legislation and understaffed inspectorate

Ravensworth

- ▶ 2013 Gaps in codes on traffic controls (lack of guidance standards across whole industry –ARRB group).

Pathway 8: Worker & supervisor concerns prior to incident

Pike River

- ▶ Leading Hydro Management consultant resigned over safety concerns, Management threatened union after it endorse safety-related withdrawal led by supervisor. Breach of century old principle in mining. Worker concerns, at least one planning to leave

Cornwall, BGM

- ▶ worker/supervisors raised concerns but were ignored

Note: this dimension seldom investigated.



Pathway 9: Poor management/ worker communication/trust

Pike River

- ▶ No effective worker input mechanisms (eg HSRs) and poor management response to worker, supervisor and union concerns (Pike River)

North Parkes

- ▶ Poor management/worker and worker/worker communication processes

BGM

- ▶ Inadequate input mechanisms (Committees & HSRs) & poor response to workers raising safety issues. Bitter struggle over unionisation

Ravensthorpe

- ▶ 2013 Inspector referred to company safety climate survey with low score for worker involvement in safety; perception of supervisor production pressure; poor safety communication between teams; low score re willingness to report mistake/errors; fatigue management was seen as issue

Pathway 10: Flaws in emergency procedures/resources

Pike River How and some incidents where contributed

- ▶ No effective second egress, poor safety management (location of ventilator machinery) made rescue or even recovery more dangerous

BGM

- ▶ No second egress too but more significant inadequate roof support made rescue more dangerous

Note: rescue chambers not alternative to second egress as oxygen supply may prove too limited for rescuers in cases of entrapment/fire.

Learning/benefiting from these findings

- ▶ Pattern causes go long way to explaining recurrent fatal incidents in high hazard workplaces & focusing on them would minimise fatalities
- ▶ Systems as hierarchies of control that corrode over time & better suited to routine risk? Need to guard against this.
- ▶ Pattern causes apply to both single fatalities and multiple fatalities (both low frequency/high impact events). Newcastle University PhD of 51 incidents reinforces this finding.
- ▶ Pattern causes generally latent failures (Reasons), any one could cause fatal incidents but more you have more likely (only requires trigger which is often minor of itself and difficult to predict/target)
- ▶ Changes to work organisation like subcontracting can weaken (11th pathway?)
- ▶ Safety 'culture' was not a pattern cause rather symptom of failure in OHS management regime and priorities

Pattern flaws provide reference point for enhancing systems

Identifying & assessing/remediating OHSMS gaps like

- Does it address all fatality risks?
- Does it sufficiently target both routine & fatality risks?
- Does it use risk-based systems & rules/remedies where hazard controls well known?
- Does it ensure risk assessment documented & changes to work organisation etc. considered?
- Does it include appropriate HPIs, KPIs & TARPs?

Pattern flaws provide reference point for enhancing systems

- Informing monitoring, incident reporting & investigation (effective HPI reporting differentiating routine/high-impact, upstream focus in incident investigation)
- Strengthening auditing requirements
- Mutually reinforcing multiple feedback loops to identify failures and ensure constructive dialogue (ie. potential for different/critical views)
- Deep listening/communication, problem solving and upstream solutions (design/exposure). Companies now targeting single fatalities, focus on fatality mechanisms, pattern causes, involvement and upstream (eg. engineering) remedies

References and thanks

- ▶ M. Quinlan (2014), *Ten Pathways to Death and Disaster: Learning from fatal incidents in mines and other high hazard workplaces*, Federation Press, Sydney.
- ▶ Hopkins, A. & Maslen, S. (2015) *Risky rewards: how company bonuses affect safety*, Ashgate, Farnham, Surrey.
- ▶ Walters, D. Quinlan, M. Johnstone R. & Wadsworth, E. (2017) Representing miners in arrangements for health and safety in coalmines: A study of current practice, *Economic and Industrial Democracy*, DOI: 10.1177/0143831X16679891
- ▶ Matthews, L. Quinlan, M. Bohle, P. (2019) Prevalence and correlates of post-traumatic stress disorder, depression, and prolonged grief disorder in families bereaved by a traumatic workplace death *Frontiers of Psychiatry* <https://www.frontiersin.org/articles/10.3389/fpsy.2019.00609/full>