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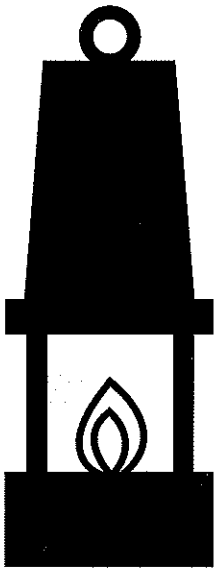

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FOREWORD

The first International Conference of Safety in Mines Research Institutes was held in 1931 in Buxton in the UK, which was then home to the UK's Safety in Mines Research Establishment (now part of the Health & Safety Laboratory). Since this time it has been held approximately every two years (with the exception of the Second World War) all around the World, making it one of the oldest, if not the oldest, global mining health & safety Conference.

Over the past 10 years it has been held in South Africa (2003), Australia (2005), China (2007), Poland (2009) and India (2011), each conference being extremely well attended with strong local and international audiences providing a common forum to researchers, safety experts, and industry professionals for the sharing, discussion and assessment of challenges and achievements in the field of mines safety.

This year the Conference makes a welcome return to the UK, where it was last held in 1983. Since that time the industry in the UK has reduced significantly, but it is still an active industry. Over this time the nature of mining safety research has also changed. Whilst "research institutes" still exist, research is also carried out by other bodies such as Universities, Consultancy's and even in-house teams within mining companies and mines. It is pleasing to have speakers representing all these types of organisation here with us this week from all over the world, not just the UK.

On behalf of the organising committee I would like to welcome all delegates to London. I hope that the presentations, the networking and friendships made here will help you in improving health & safety in the mining industry around the world.

Dr Patrick Foster
Chairman
35th International Conference of Safety in Mines Research Institutes

History of the International Conference of Safety in Mines Research Institutes

1931	1st	Buxton, UK
1933	2nd	Montlucon, France
1935	3rd	Dortmund, Germany
1937	4th	Brussels&Paturages, Belgium
1948	5th	Pittsburgh, USA
1950	6th	Verneil en Halatte, France
1952	7th	Buxton, UK
1954	8th	Dortmund- Dearne, Germany
1956	9th	Brussel& Heerlen, Belgium
1958	Restricted	Verneil en Halatte, France
1960	10th	Pittsburgh, USA
1961	Restricted	Warsaw, Poland
1963	11th	Aix-les-Bains, France
1965	Restricted	Sheffield, UK
1967	12th	Dortmund, Germany
1969	13th	Tokyo, Japan
1971	14th	Donetsk, USSR
1973	15th	Karlovy vary, Czechoslovakia
1975	16th	Washington DC, USA
1977	17th	Varna, Bulgaria
1979	18th	Dubrovnik, Yugoslavia
1981	19th	Katowice, Poland
1983	20th	Sheffield, UK
1985	21st	Sydney, Australia
1987	22nd	Peking, PRC China
1989	23rd	Washington DC, USA
1991	24th	Donetsk, USSR
1993	25th	Pretoria, South Africa
1995	26th	Katowice, Poland
1997	27th	New Delhi, India
1999	28th	Sinaia, Romania
2001	29th	Szczyrk, Poland
2003	30th	Johannesburg, South Africa
2005	31st	Brisbane, Australia
2007	32nd	Beijing, China
2009	33rd	Wisla, Poland
2011	34th	New Delhi, India
2013	35th	London, UK

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President, MIRARCO, Canada

35th International Conference of Safety in Mines Research Institutes

Tuesday 15th October 2013

08:30-10:15	REGISTRATION AND COFFEE	
10:15 -11:00	**Welcome & Introduction**	
11:00 – 12:00	**Keynote Addresses.** **The Pike River Royal Commission, Lessons from the Antipodes** *Stewart Bell, Pike River Royal Commission [Aus]* **ICMM: improving health and safety performance in the mining sector** *Mark Holmes, International Council on Mining & Metals [UK]*	
12:00-13:15	**LUNCH**	
	SESSION 2A: STRATA CONTROL 1 **Chair: Paul Holmes, British Gypsum**	**SESSION 2B: MINES RESCUE 1** **Chair: Barrie Jones, Mines Rescue Service Ltd**
13:15	**Application of Rockfall Risk Assessment for Surface Mining Operations** *J Coggan, Camborne School of Mines, University of Exeter [UK]*	**Mines Rescue Communications** *David Lewis[1], Mustanir Ali[1], Roy Tallon[2], [1]Golder Associates (UK) Ltd, [2]New Boliden Tara Mine [UK/Eire]*
13:40	**Slope Failure Monitoring using full waveform terrestrial laser scanning in open pit mining** *A Afana [1,2], G Hunter[2], J Davis[2], J Williams[1], R Hard[1], N Rosser[1], [1]Durham University, [2]3d Laser Mapping Ltd [UK]*	**Long Range Wireless Links for Mines Rescue Communications** *Mike Bedford & Gareth Kennedy, Camborne School of Mines [UK]*
14:05	**A New Approach to Rockfall Risk Assessment & Design** *Thomas Clifford, Atkins Global [UK]*	**Advances in Underground Personnel Location Technologies** *Angel Rodriguez[1], José Ramón Medina[2], Jacinto Hidalgo[2], [1]AITEMIN, [2]Adaro Tecnología [Spain]*
14:30	**REFRESHMENT BREAK**	
	SESSION 3A: EXPLOSIONS, IGNITIONS & METHANE 1 **Chair: Bob Leeming, Health & Safety Executive**	**SESSION 3B: HEALTH 1** **Chair: Robin Burgess-Limerick, MISHC**
14:45	**An Approach towards Designing Guidelines for Reducing Frictional Ignition Risks Caused Due to Continuous Miner in Underground Coal Mines** *Shubham Kankane, Indian School of Mines [India]*	**MIning+Health: Outcomes of a New Research Initiative at MISHC/UQ** *Philipp Kirsch, Minerals Industry Safety and Health Centre, University Of Queensland [Aus]*

15:10	**Non Destructive Testing of Insitu Underground Mine Seals: Update of Technology Assessment** *C Harwood, B Lusk, K Luxbacher & E Westman, Virginia Polytechnic Institute and State University [US]*	**Analysis of Vibrations Exposure in Open Pit Mobile Equipment. Influence of the Measuring Methodology** *Pedro Morillo, Florencio Fernández, José-Luis Fuentes-Cantillana, AITEMIN [Spain]*
15:35	***Strength Tests of Explosion-proof Stoppings in the Underground Research Installation at Experimental Mine "Barbara" CMI*** *Krzysztof Cybulski, Central Mining Institute Experimental Mine Barbara [Poland]*	**An Assessment of the Physiological Strain Experienced by Male and Female Mineworkers** *Schu Schutte, CSIR Centre for Mining Innovation [RSA]*
16:00		**Whole Body Vibration: A Mine Based Study** *James.Noblett, Winsford Salt Mine, Compass Minerals [UK]*
16:25	CLOSE OF DAY 1	

Wednesday 16th October 2013

0900 – 09:30	**Keynote Address.** **The UK Legislative Review and its Implication for the Industry** *Steve Denton, HM Chief Inspector of Mines, HSE*	
	SESSION 4A: MONITORING **Chair: Prof Mike Nelson, University of Utah**	**SESSION 4B: SHAFTS** **Chair: Alan Auld, Alan Auld Associates**
09:35	**Integrated Underground Mine Monitoring** *Vicente Gutierrez Peinador, Angel Reguant, Isabel Martinez, Iberpotash S.A.[Spain]*	**Experimental and Numerical Modelling of the Weathering Effects on Shaft Lining Material** *Wenbo Yang, Yudan Jia, Alec Marshall, [1]University of Nottingham [UK]*
10:00	**Controlling the Genie: Software Management in the Underground Mining Industry** *John Ford, UK Inspectorate of Mines, HSE [UK]*	**Going Down the Shaft Safety Route on Crusader Avenue (Case Study)** *George Nelson, Matthew Rowton, The Coal Authority [UK]*
10:25	**Mining Industry Mobile Sensor: Monitoring the Health and Safety of Mine Workers** *Stephen Jackson, Barrie Hayes-Gill, John Crowe, Paul Rodmell, Chris Cross, The University of Nottingham [UK]*	**Herrenknecht Mining** *Benjamin Künstle, Werner Burger, Herrenknecht AG [Germany]*
10:50	**REFRESHMENT BREAK**	
	SESSION 5A: SAFETY MANAGEMENT 1 **Chair: Steve Denton, Health & Safety Executive**	**SESSION 5B: ELECTRICAL SAFETY & NEW TECH 1** **Chair: Gareth Kennedy, Camborne School of Mines**
11:20	**Vision Zero – The New Global Strategy for Safe Mining** *Helmut Ehnes, BG Rohstoffe und chemische Industrie, Director Prevention [Germany]*	**Blasting of a Mined Tunnel in Close Proximity to Existing High Voltage Cable Tunnels** *Tsz Hang Lawrence Lee[1], TH Lawrence Lee[2], Timothy Magub[3], [1]MTR Corporation Limited, [2]MTR Corporation Limited, [3]Leighton Contractors (Asia) Limited*
11:45	**Are We There Yet? Reforms, Harmonisation, Risk Assessment and Mine Safety Management in Australia** *Manikam Pillay[1], Michael Tuck[2], [1]University of Ballarat, [2]School of Science, Information Technology and Engineering, University of Ballarat [Aus]*	**Superfast Short Circuit Current Interruption with Protection Devices on an Electrohydraulic Basis** *A. G Mnukhin, Makeyevka State Safety in Mines Research Institute [Ukraine]*

12:10	**Courageous Leadership** *David Vint, ArcelorMittal Mining [UK]*	**Accurate Location of Explosive Misfires Using a Single Channel Detector** *Ken Liddell, ISVR, University of Southampton [UK]*
12:35	**Commercial Risks of Safety: Are Profit & Safety Mutually Exclusive** *Natasha Kendall, Innovation Consulting [Aus]*	**Fibre Optics Optimization for Coal Mines Automation with Special Focus on Longwall Process** *Sharans Kabra, Indian School of Mines, Dhanbad [India]*
13:00	**LUNCH**	
	SESSION 6A: TRAINING **Chair: Dirk van Zyl, University of British Columbia**	**SESSION 6B: HEALTH 2** **Chair: Ashis Bhattacherjee, Indian Institute of Technology**
14:00	**Prevention is Better than Cure** *Andrew Watson, Mines Rescue Service Ltd [UK]*	**Nitrogen Oxides in German Potash & Hard Coal Mining – Exposure Assessment within 2 epidemiological studies** *Dirk Dahmann, IGF Institute for Hazardous Materials [Germany*
14:25	**Configuring of Virtual Working Environment for Safety Related training in the Mining Industry** *Teodor Winkler, Dariusz Michalak, Lukasz Jaszczyk, Institute of Mining Technology KOMAG [Poland]*	**Field Performance of Innovative Spray Systems for Continuous Miners for Dust Control** *Yoginder Chugh, Harrold Gurley, Southern Illinois University [USA]*
14:50	**The Benefits of Laser Scanning and 3D Modelling in Accident Investigation: In a Mining Context** *Matthew Eyre[1], Dr Patrick Foster[2], Dr James Jobling-Purser[3], [1]Camborne School of Mines, University of Exeter, [2]Camborne School of Mines, [3]3D Mine Surveying International [UK]*	**Experimental Studies on Respirable Dust Distribution in Mine Airways on the Basis of Real-time Dust Monitoring** *Dariusz Obracaj, AGH University of Science & Technology [Poland]*
15:15	**REFRESHMENT BREAK**	
	SESSION 7A: STRATA CONTROL 2 **Chair: John Coggan, Camborne School of Mines**	**SESSION 7B: RISK ASSESSMENT 1** **Chair: David Cliff, MISHC**
15:40	**A Dynamic Approach to the Management of Fall of Ground Risk** *Paul Holmes, British Gyspum/Saint Gobain [UK]*	**Risk Assessment of Occupational Accidents at a Continuous Miner Worksite: An Epidemiological Study** *Ashis Bhattacherjee, Karthik Ravichandran, Indian Institute of Technology [India]*
16:05	**Field Performance of Alternate Mining Geometries for Set-Up Rooms and Development Entries in Longwall Mining** *Yoginder Chugh[1], Harrold Gurley[2], Behrooz Abbasi[1], [1]Southern Illinois University, [2]Southern Illinois University [USA]*	**Resilience - The New Risk Management** *Dirk Van Zyl[1], Corrie Pitzer[2], [1]Norman B. Keevil Institute of Mining Engineering, [2]RISKmap [Canada]*

16:30	**Improved Underground Safety through Recent Developments in Coal Mine Ground Control Instrumentation** *David Bigby, Keith MacAndrew, John Toplis, Liam Sneath, Golder Associates (UK)*	**Using a Task-based Risk Assessment Process (EDEEP) to Improve Equipment Design Safety: A Case Study of an Exploration Drill Rig** *Johanna Weste[1] Robin Burgess-Limerick[2], [1]Sandvik Mining, [2]Minerals Industry Safety and Health Centre [Aus]*
16:55	**Obtaining the Physical Properties of Soft Rocks** *Raveed Aslam, Yan Geng, Yudan Jia, Rod Stace, University of Nottingham [UK]*	**Probabilistic Risk Assessment of Mine Systems** *Ranjan Kumar[1], RANJAN Kumar[2], Achyuta Krishna Ghosh[2] [1]CSIR-Central Institute of Mining and Fuel Research, [2]CSIR-CENTRAL INSTITUTE OF MINING AND FUEL RESEARCH [India]*
17:20	**CLOSE OF DAY 2**	
19:30-22:30 (TBC)	**CONFERENCE DINNER**	

Thursday 17th October 2013

	SESSION 8A: STRATA CONTROL 3 **Chair: Rod Stace, University of Nottingham**	**SESSION 8B: RISK ASSESSMENT 2** **Chair: Patrick Foster, Camborne School of Mines**
09:15	**Measuring and Monitoring to Understand and Reduce the Fall-of-Ground Risk** *Van Zyl Brink, Declan Vogt, CSIR Centre for Mining Innovation [RSA]*	**Fault Tree Analysis of Hazards Associated with the Use of Booster Fans in Underground Coal Mines** *Mahesh Shriwas, Felipe Calizaya, Michael Nelson, University of Utah [USA]*
09:40	**Extending the life of the UK's largest Salt Mine (Strata control at Greater Depth.** *Gordon Dunn, Compass Minerals [UK}*	**Could RISKGATE be applied to Industry Scale Knowledge Management in European Mining** *Philipp Kirsch[1], Minerals Industry Safety and Health Centre, University of Queensland [Aus]*
10:05	**Analysing Slope Stability Using LiDAR (Light Detection and Radiation)** *Md Shahid Anwar, Sunny Soarabh, Indian School of Mines [India]*	**Roof Fall Major Hazard Analysis with BowTie Diagrams** *Patrick Foster[1], Richard Severn[2], [1]Camborne School of Mines, University of Exeter, [2] Cleveland Potash Ltd [UK]*
10:30	**REFRESHMENT BREAK**	
	SESSION 9A: SAFETY MANAGEMENT 2 **Chair: Gordon Dunn, Compass Minerals**	**SESSION 9B: EXPLOSIONS, IGNITIONS & METHANE 2** **Chair: José-Luis Fuentes-Cantillana, AITEMIN**
11:00	**Impact Assessment of Industrial, Social and Economic Factors on Accident Rates and Occupational Morbidity of Workers at Vorkuta Coal Mines** *Semen Gendler, National Mineral Resources University "Mining" [Russia]*	**Pike River Coal Mine Disaster - What actually happened?** *David Cliff[1], Ruth Fuller[2], Tim Horberry[2] [1]Minerals Industry Safety and Health Centre, [2]MISHC U of Q [Aus]*
11:25	**Disasters, Accidents and Safety: A Review of Theory and Applications for Advancing Mine Safety Management** *Manikam Pillay, University of Ballarat [Aus]*	**The Impact of Atmospheric Pressure Drops on Deep Pit Coal Mines Safety** *Philip Beauvais, Met Office [UK]*
11:50	**Whole Systems Design in Safety Research at the University of Utah** *Michael G Nelson, University of Utah [USA]*	**Simulation and Monitoring of Methane Concentration Transients in Longwall Region** *Jerzy Krawczyk, Stanisław Wasilewski , Strata Mechanics Research Institute of Polish Academy of Sciences [Poland]*

12:15	**Study of the Safety Requirements Effectiveness in the Large Iranian Mines in 1380s and Detail Comparison with the Developed Countries, An Outlook** *Behzad Abbaspour, Farshad Rashidinejad, Science and Research Branch (SRB), Islamic Azad University (IAU) [Iran]*	**Coal Mine Methane Drainage in Conditions of Polish Coal Mines** *Nikodem Szlazak, Dariusz Obracaj, Marek Borowski, Marek Korzec, Justyna Swolkien, AGH University of Science & Technology [Poland]*
12:40	**LUNCH**	
	SESSION 10A: MINES RESCUE 2 **Chair: Stewart Bell, Queensland**	**SESSION 10B: ELECTRICAL SAFETY & NEW TECH 2** **Chair: Ken Liddell, University of Southampton**
13:30	**EMTECH (Mine Emergency Support Technologies)** *Fernando Portugués, GEOCONTROL, SA [Spain]*	**The Role of Friction Supply Estimation in the Design of Surface Mine Haul Roads** *R Thompson[1] & D Tulloch[2], [1]Curtin University WA School of Mines, [2]Road Safety Training Services Pty Ltd [Aus]*
13:55	**Underground Oxygen Self Rescuer Fire** *V. Fowler, R. Leeming, UK Inspectorate of Mines, HSE [UK]*	**Using Borehole Deployable Laser Scanning to improve Mine Safety** *Anthony Comber, MDL Laser [UK]*
14:20	**Large Diameter, Life-saving Drilling Rigs and Technologies for Miners Rescue** *Ingo Rott, PRAKLA Bohrtechnik Gmb [Germany]*	**Orphan Mines** *Martin Morales de Castilla Gonzalo, Administration of the Principality of Asturias [Spain]*
14:45	**Improving the Next of Kin Management Process** *Natasha Kendall – Innovation Consulting [Aus]*	**Usage of Environmentally-Safe Electric Discharge in the Coal Industry** *A.G Mnukhin, Makeyevka State Safety in Mines Research Institute [Ukraine]*
15:10	**CLOSING REMARKS**	
16:00	**REFRESHMENTS & DEPART**	

Are we There yet? Reforms, Harmonisation, Risk Assessment, and Mine Safety Management in Australia

Manikam Pillay[1] and Michael Tuck[2]

ABSTRACT

For over four decades health and safety in Australian mines has been regulated through a myriad of health and safety laws administered by the states and territories. These differences have meant that workers in different parts of the country who faced similar health and safety risks were provided with different levels of legal protection; mining companies operating in more than one sate or territory were subjected to different standards and enforcement, and placed increased burdens of cost for compliance and enforcement. Responding to industry's calls for consistency and uniformity for over two decades, the Federal Government has finally moved by developing and issuing a common legal framework for the legal administration and management of health and safety. When fully adopted, the harmonised legislation was expected to pave the way for a consistent and uniform approach to way health and safety risks are managed in the mining industry in Australia. However, two years after being proclaimed, this process is still not complete as the legislation has not been fully adopted by all states and territories. This paper examines reforms in health and safety law in Australia, compares and contrasts the legal frameworks for mine health and safety in the three states of New South Wales, Queensland and Western Australia. It concludes with a discussion on what the harmonisation means for risk assessment and safety management for Australian mining companies.

KEYWORDS: Harmonisation, Model WHS Act 2010, Model WHS Regulations 2011, Codes of Practice

1. INTRODUCTION

Australia is a Federation of six states and two territories. Under the country's constitution the power to legislate for safety is vested in the states and territories, not the commonwealth [1]. As a result the six states Acts and two Territories have developed their own set of safety laws. The first set of safety laws in the Federation, introduced between 1833 and 1844, were largely prescriptive, comprised of minimum safety standards, and based on the framework of 19th century British Factory Acts, supplemented with regulations [2]. The benefits of this were that organisations knew precisely what the requirements were, and the standards were relatively easy to enforce [3]. However, these laws were also limited in their ability to bring about sustainable improvements in safety at workplace level. For example, they included a mass of detailed and technical rules which were often difficult to understand by those who the laws were designed to protect; many standards were developed ad hoc to resolve problems as they arose; and concentrated mainly on factory-based physical hazards, resulting in uneven coverage across the industries; the specification standards did not encourage employers to be innovative in terms of seeking cheaper or more cost-efficient solutions [2, 4]. The traditional legislation was deemed too rigid and complex and unable to keep pace with developments in social, economic and technological changes [5], and creating a climate of dependence on state regulation with little involvement by workers, unions, safety representatives or committees [6].

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[2] MAusIMM, Associate Professor Mine Engineering, School of Science, Information Technology and Engineering, University of Ballarat, Australia.

2. REFORMS IN AUSTRALIAN SAFETY LAWS

Since being introduced, there have been at least three main attempts at reforming safety laws in Australia. The first occurred in the 1970's and followed recommendations of the Roben's committee [1]. The committee found three main defects with the (then) British legal system and administration of safety laws; (i) there was too much law, (ii) the laws were badly structured, too detailed, besieged with obsolete provisions, with lack of attention given to attitudes, capacities and performance of people and efficiency of the organisational system where they worked, and (iii) fragmented jurisdictional control which meant not all workers were provided protection for safety and made harmonising, servicing and updating the numerous statutory provisions extremely difficult [7]. The key recommendations made by the committee involved (i) transferring regulatory burden from the safety inspectorate to the employer; (ii) broad goal-setting framework; (iii) general duties, and (iv) self-regulation in terms of involving unions in setting standards [8]. Between 1972 and 1993 the Commonwealth, states and territories in Australia had embraced Roben's, leading to safety laws shifting from detailed and technical specifications to a more self-regulatory and performance-based approach [2, 9]. These reforming Acts placed broad 'general duties' of care on employers, self-employed persons, persons in control of workplaces, employees, designers, manufacturers and suppliers of plant and substances, and erectors and installers of structures; parties deemed to have a significant influence on health and safety. The standards were moved from the Acts into subordinate regulations, and a number of processes (such as consultation, identification of hazards, assessment of risks, and methods of controlling risks) that deemed necessary in achieving safety were also added on [2, 9]. Codes of practice (CoPs) which were either hazard-based, process-based or systems-based were also developed and issued to assist companies meet the standards [10, 11]. This approach towards self-regulation was seen as a move away from state responsibility to some deregulation [12]. It also meant more emphasis on persuasion, collaboration, training and education [13].

However, while the legislation still followed the common three-tiered approach proposed by Roben's, there were still many differences in structure, details, coverage, and matters between the Acts, regulation and CoPs [9, 11]. Moreover, the reformed laws had limited success in addressing the central concern associated with high economic and social burden posed by work-related injuries and diseases [14]. The differences in laws and specific requirements between states have also been suggested to increase burdens of costs to organisations that operate across more than one state, and on state governments in charge of enforcing them [15]. Hence calls for more uniformity and harmonisation have been part of the Federal government's agenda for the last twenty years [1].

The second major reforms in the 1990s were a first attempt towards national uniformity. Initiated by the National Occupational Health and Safety Commission (NOHSC) and later by the Australian Safety and Compensation Commission (ASCC), these focussed on developing National Standards (NS) and CoPs in a number of 'first order' priority issues such as manual handling, plant, hazardous substances, noise, certifications and major hazard facilities [9]. However, the NSs or CoPs did not have legal status and were not enforceable unless they were adopted by the states and territories as part of their Acts and/or regulations. Moreover, because there was no binding agreement nationally on the adoption of NSs, consistency varied across the states and territories, and the process became cumbersome, with some jurisdictions incorporating the provisions into their safety statutes or regulations (making them mandatory), while others incorporated them into CoPs or guidance notes, which permitted duty holders to achieve the required results in more than one way [9]. One could argue uniformity was never actually achieved because of what resulted; over 9 safety Acts, and some 50 additional legislative instruments applying to a range of activities (such as offshore petroleum, mining, construction), issues such as public health (e.g. radiation, agriculture and veterinary chemicals) and public safety (e.g. amusement equipment, electrical safety, plumbing and gas safety, machinery, scaffolding and lifts), together with statutes relating to explosives, transport of dangerous goods and radioactive materials [11, 15].

The most recent reforms commenced in 2006 as a move towards national harmonisation. In 2008 it was agreed that 'model legislation' was the most effective way to proceed towards harmonisation, leading to the signing of an Intergovernmental Agreement for Regulatory and Operational Reform in Occupational Health and Safety [9]. This was the first concerted attempt at committing towards harmonisation of safety laws and a set timeframe for a complete and fully integrated package, under a National Compliance and Enforcement Policy [16]. The harmonised framework was declared between 2010 and 2012 following extensive consultations with unions, employers and public. The broad framework is a three-tiered structure comprised of a Model Work Health and Safety Act (WHSA) and Model Work Health and Safety Regulations (WHSR), supported with Model CoPs, illustrated in Figure 1.

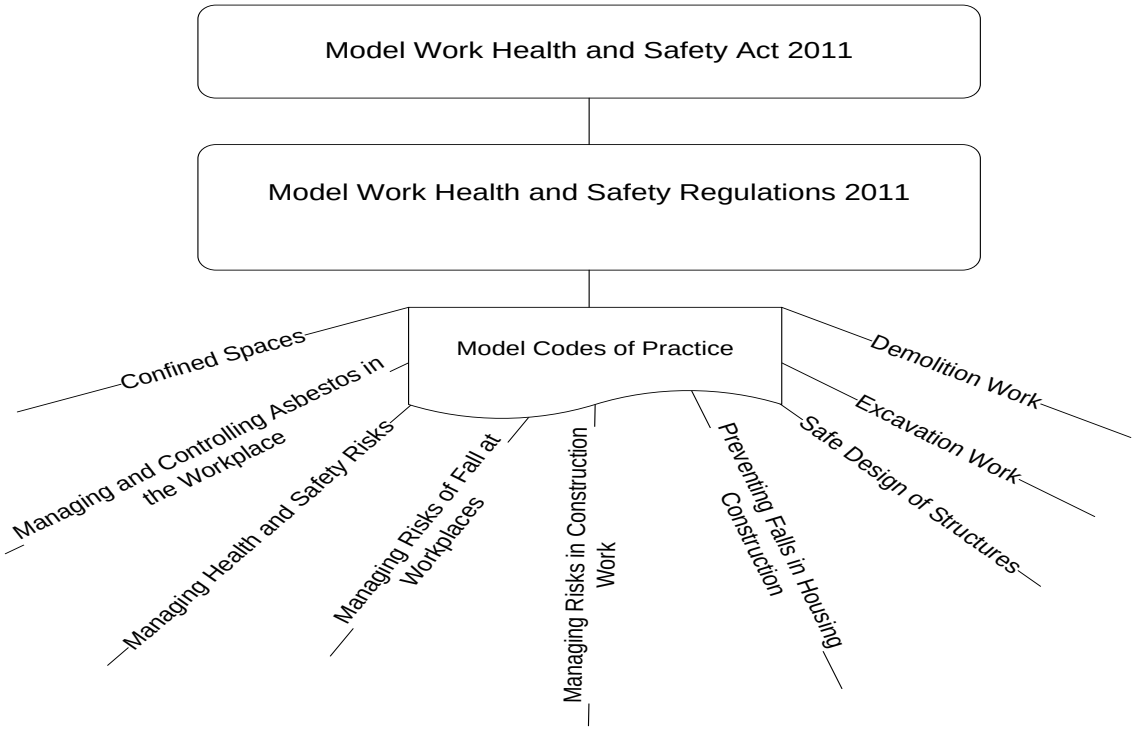

Figure 1: Framework of Harmonised Safety Laws in Australia [11]

In effect the framework is the one originally proposed by the Roben's committee and adopted by all states and territories. The Model Act and Regulations are legal requirements and establish duty of care requirements, set performance standards and establish a number of processes. The Federal government expected this harmonised framework to be adopted by all states and territories such that by the beginning of 2013 all workers across the country will be the covered by the same set of safety standards. However, the WHS Act and Regulations have not been fully adapted by all states and territories in the manner expected. What this means that workers across some states may not be afforded the same level of safety protection, and organisations operating in more than one some state likely to be the subject of higher than normal costs of compliance [17, 18].

3. HARMONISATIONS OF MINE SAFETY LEGISLATION

The Australian mining industry has always been treated as special case for safety [11]. The severity and distinctiveness of hazards experienced, a historically high level of work related fatalities, incidents and diseases, and a record of major disasters have all resulted in a perception that it should be treated differently from the mainstream industries [10, 11]. These, together with arguments from key influential industry leaders that more specialised skills were required for effective regulatory oversight of the mining sector in comparison with traditional manufacturing and construction industries has meant the industry has always been the subject of a separate mine

health and safety regime [19], particularly in the resource-rich states such as New South Wales, Queensland and Western Australia [10]. One outcome of this separation is that these states have generally been slower to learn from mainstream safety research [20], resulting in significant gaps between developments in health and safety theory and practice and its legal application. In an attempt to narrow the gap, a number of reforms were initiated between 1999 and 2011. Although these reforms did not abolish mine-specific legislation, they embraced broad-based general duties, and (to a lesser degree) performance standards.

In tandem with harmonisation of mainstream safety laws, work has been underway for at least a decade to create a nationally consistent mine safety regulatory regime in the country. This has been initiative of the National Mine Safety Framework (NMSF), established in 2002 by the (then) Ministerial Council on Mineral and Petroleum Resources [21]. In 2009 the coalition of Australian governments (COAG) agreed to implement NMSF by:

(i) developing and implementing national mine safety provisions,
(ii) delivering training packages at a national level,
(iii) developing national guidance materials (CoPs),
(iv) establishing an online repository of compliance information to assist duty holders,
(v) adopting a national enforcement implementation guideline,
(vi) establishing a national mine safety database to capture health and safety information, including incidents as diseases, and
(vii) embracing effective consultation mechanisms and a collaborative approach to research.

As originally conceived, the model Act, when adopted by the states and territories, would apply to mining operations, with specific Chapter in the Model Regulations devoted to Mine Safety. A Draft Model WHS (Mines) Regulations, supported with a series of CoPs for Mining were released for public comment in July 2011. These regulations are expected to form the 'core' of mine safety and therefore form part of state and territory regulations, with further 'non-core' requirements to supplement the model regulations in the states of New South Wales (NSW), Queensland (QLD) and Western Australia (WA). The intended date for implementation of harmonised mine safety laws was 1 January 2012, so that similar to mainstream safety laws, all states and territories would be subjected to the same set of performance standards. However, the state and territory Ministers' Standing Council on Energy and Resources sought an extended timeline of 31 December 2012. This delay has meant that harmonisation of mine safety has not been achieved as well.

In the next section mine safety laws in the three states of NSW, QLD and WA are briefly presented.

3.1 New South Wales (NSW) Safety Legislation

Until 2001, Mine Safety in NSW was regulated through a number of industry-specific laws for regulating hazardous industries, including the *Coal Mines Regulation Act 1901, Coal Mines Regulation Act 1912* and the *Coal Mines Regulation Act 1982* (CMRA) [22]. A new set of laws for coal mining safety was declared in 2002 and commenced in 2006. The *Coal Mine Health and Safety Act 2002* (CMHSA) and *Coal Mine Health and Safety Regulations 2006* (CMHSR) were developed to address recommendations of the Mine Safety Review in 1997 and the Gretley Inquiry Report in 1998. These investigated the death of four men after an inrush of water from abandoned workings at Gretley colliery in 1996. One of the main recommendations in these reports was replacement of the prescriptive regulations under CMRA with a systematic risk management approach [22]. Following a wider consultation about issues relevant to the development of regulations to support the CMHSA, the 2004 Wran Mine Safety Review recommended the CMHSR be introduced as a matter of priority, in addition to a mine safety act that could apply to non-coal mining and quarrying operations. The results were a *Mine Health and Safety Act 2004* (MHSA) and *Mine Health and Safety Regulations 2006* (MHSR). Currently there are at least six pieces of legislation that apply to mining safety in NSW (Figure 2).

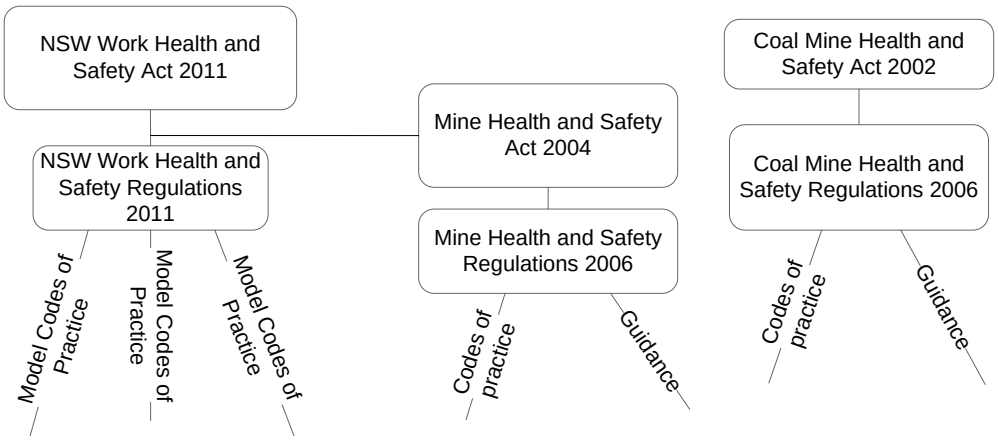

Figure 2: Framework of Mine Safety Laws in NSW

The mainstream *WHS Act 2011*, implemented as a part of harmonisation, apples to mining. This is complemented with a *MHSA and MHSR,* both of which are subordinate legislation under the mainstream safety Act, in addition to coal mine safety laws. The specific requirements in these statutes are, to a large extent, based on performance standards and duty of care arrangements, hence mirrors mainstream safety laws [21]. Authors such as Gunningham [10] have commented that organisation that comply only with the mining specific statutes are not necessarily protected from prosecution from general duties of mainstream legislation; in effect mining companies need to formally comply with two regulatory regimes.

3.2 Queensland (QLD) Safety Legislation

Major reforms were implemented in QLD 1999 resulting in a three-tiered framework of mainstream Safety legislation, with two specific Acts being enacted. These included the *Coal Mining Safety and Health Act 1999 (CMSHA),* and the *Mining and Quarrying Safety and Health Act 1999 (MQSHA).* Both Acts are supported with their own set of regulations, including the *Coal Mining Safety and Health Regulations 1999* and the *Mining and Quarrying Safety and Health Regulations 2001* (Figure 3).

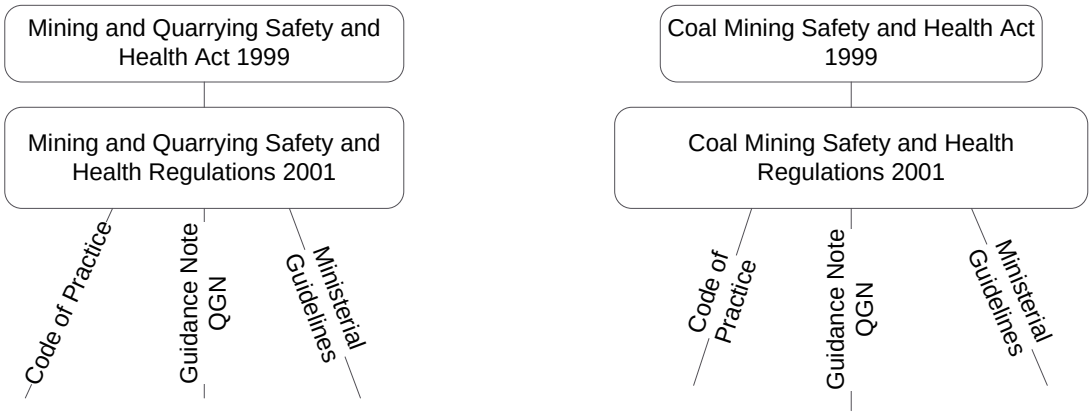

Figure 3: Framework of Mine Safety Laws in QLD

The approach aimed to complement mining and non-mining mainstream safety legislation [10].

3.3 Western Australia (WA) Safety Legislation

Western Australia has single Act and a single set of regulations that covers all types of mining. The key legislation is the *Mines Safety and Inspection Act 1994* which is supplemented by the *Mines Safety and Inspection Regulations 1995* (Figure 4).

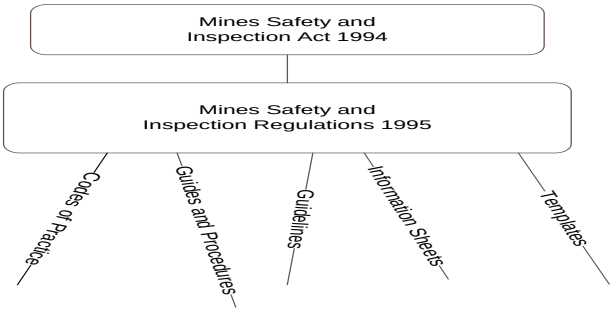

Figure 4: Framework of Mine Safety Laws in WA

MSIA and MSIR replaced the *Mines Regulation Act 1946* and the *Coal Mines Regulation Act 1946*. The mainstream safety law, *Occupational Safety and Health Act 1984* exclude mines.

The main difference between the WA safety law, in comparison with the laws of NSW and QLD, is a reliance on prescriptions on top of general duties and risk-based provisions [10]. Hence, although modelled on Roben's, the current approach is a reminiscent of traditional safety legislation [20]. This, however, does not necessarily mean the other two states do not have some degree of prescriptions; in the main they all have some prescriptions, general duties, performance-based standards and systematic process-based requirements (Table 1).

Table 1: A Comparison of Mine Safety Laws [19]

Type of standard	NSW		QLD		WA	
	No.	%	No.	%	No.	%
Prescriptive standards	75	56	57	46	57	61
General duties	4	3	2	2	0	0
Performance-based standards	29	22	39	31	24	26
Systematic process-based standards	14	10	15	12	1	<1
Pages of regulations examined	44	63	68	27	47	12

The mining and mainstream safety laws in the three states should at least, in theory, prevent any potential for inconsistency in the way the standards and duties are applied to any mine. However, the mere existence of separate Acts and regulations supposed to achieve the same outcomes (albeit for different worksites and activities) can be confusing to those operating on the blunt end of risks. In particular, safety issues associated with construction work on mining sites in NSW and WA, for example would be the subject of both mainstream safety as well as mine safety requirements [17].

4. RISK ASSESSMENTS

Table 1 suggests that there are a number of differences between the states with respect to more specific and detailed risk-based requirements in mine safety legislation. The harmonised mine safety laws propose an incorporation of many of the existing arrangements that is currently in place. This includes adoption of a general risk management approach aimed at identifying hazards, assessing and controlling risks [23].

4.1 Hazard Identification

The harmonised laws suggest attention should be paid to four different groups of hazards, namely

(i) principal mining hazards,
(ii) other hazards that might result in significant consequences,
(iii) common 'high frequency' hazards such as manual tasks, use of power tools, slips, trips and falls, and
(iv) new or unexpected hazards [23, 24].

4.2 Assessment of Risks

Risks relating to each of the above hazard groups generally require assessment in different ways. The hazards are expected to be assessed both separately as well as with other hazards as the interactions may lead to other risks.

(i) *Principal mining hazards* are required to be assessed individually and also with other hazards in case there is potential for the combination to increase risks. The investigation and analysis is required to be specific and appropriate to the hazard, and the results documented.
(ii) *Other significant hazards* can be the subject of more generic risk assessments, and restricted to determining if there is anything different or unusual about the risk the hazards might pose in particular work areas. Assessment of these types of hazards is expected to consider relevant standards, procedures and controls that have been developed over time.
(iii) *Common 'high frequency' hazards* are generally well known and have well understood controls available. Assessment is generally not deemed necessary for such hazards under the mainstream safety laws; if these have to be taken they can again be restricted to determining if there is anything different or unusual about the risk the hazards might pose in particular work areas.
(iv) *New or unexpected hazards* are required to be assessed with a number of processes from thorough, documented 'change management' through to a simple on-the-spot job safety analyses. This is expected to be most challenging issue for mine safety [23, 24].

The harmonised mine safety laws require that, when assessing risks, the mine operator needs to take into account the following four things:

I. nature of the hazard or risk
II. likelihood of the hazards or risk causing harm
III. possible severity of the harm, and
IV. state of knowledge about the hazard or risk and how to eliminate or minimise them [23, 24]

This is generally in addition to:

a. effect of different operating conditions - normal or abnormal,
b. past incidents and potential emergency situations, and
c. past work activities, current activities and planned activities [23, 24]

5. MAJOR HAZARD AND SAFETY MANAGEMENT SYSTEMS

Due to the nature of the mining industry, some process-based standards are deemed necessary to account for the inherent hazards and risks that exist in mining. This has led to the requirements for major hazard management plans and safety management systems, in addition to identification of hazards, assessment and control of risks. In essence, these are the main ways in which safety is expected to be managed in mines. In the next section we look at the mine hazard and safety management requirements under the harmonised safety laws

5.1 Major Hazard Management Plans

Major hazard management plans map out the process or processes for the identification, assessment and control of major hazards in the workplace. Regulation 9.1.4 of the WHS Regulations define a principal mining hazard as any activity, procedure, plant, structure, process,

substance, situation or other circumstance that could result in multiple fatalities over time or pose a serious risk to safety as a result of

- ground or strata instability
- inundation and inrush
- mine shafts and winding operations
- roads and other vehicle operating areas
- air quality, dust and other airborne contaminants
- fire or explosion
- gas outbursts, and
- ionising radiation [24].

Principal mining hazards are singled out for special consideration because they have specific relevance to mining activities. They also have the potential to cause an incident with very serious consequences if not adequately controlled, even though the likelihood of it happening may be low. Because the risks associated with such types of hazards are not always obvious, the regulations require them to be managed in a systematic way. They are also required to be assessed both separately and in combination in case there are interactions flowing from one to the other. The main means of managing them is through a principal hazards management plan (PHMP). Figure 5 illustrates these linkages in the PHMP.

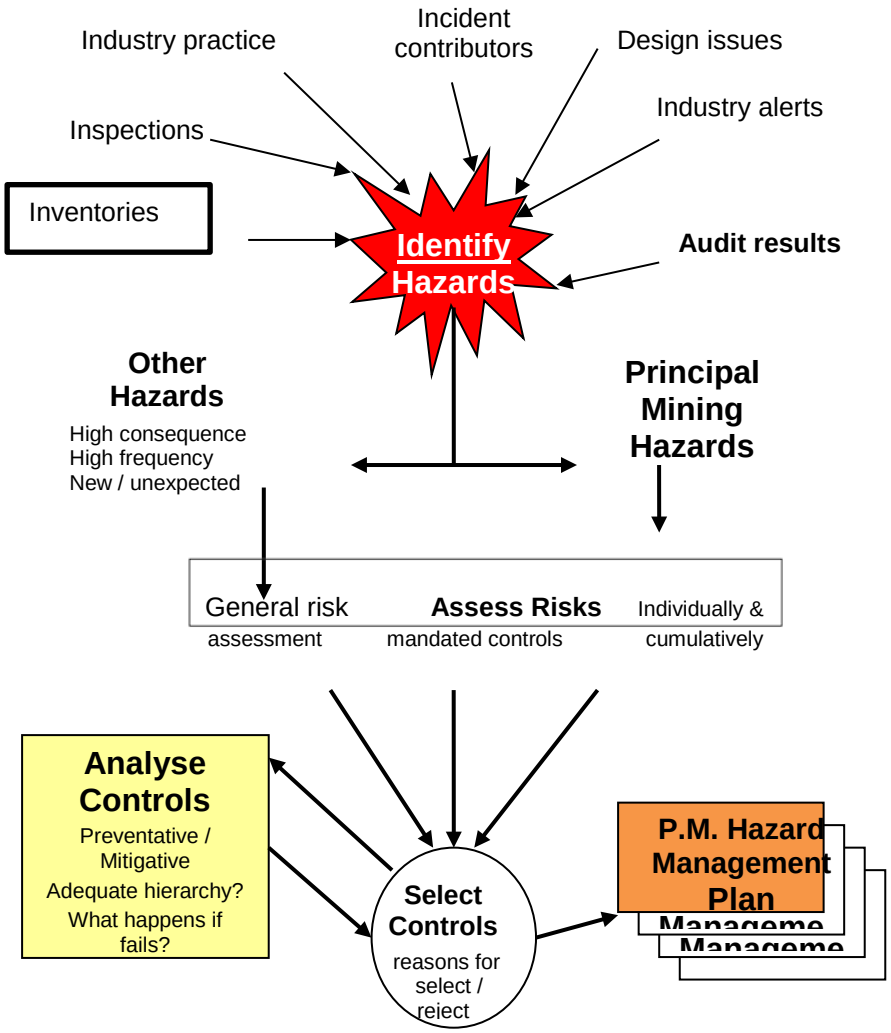

Figure 5: Components of the hazard management elements showing links to the PHMP [25]

5.2 Work Health and Safety Management System (WHSMS)

The other additional requirement, a WHSMS, is the primary means of ensuring the safe operation of a mine. The harmonised safety laws require that a WHSMS is required to address the risks and complexity of the mine operations, and is expected to include ten key elements, listed in Table 2.

Table 2: Requirements of a WHMS for Mine Safety [25]

1. Policy – R9.2.6 (1) (a)
2. Management – R9.2.6 (1) (c)
3. Operations
4. Maintenance system
5. Hazard management process – R9.2.6 (1((h)
6. Emergency response plan – Division 4, Part 2
7. Communication arrangements – R9.2.42
8. Training
9. Incident management
10. Record management

In essence a WHSMS is expected to include all the elements of a PHMP, but are expected to be more holistic in addressing safety in mining operations. Once developed, they are required to be submitted to the relevant regulator and are expected to be continuously reviewed.

CONCLUSION

The harmonised mine safety laws have been long in coming, and the proposed framework can be regarded as a good starting point, especially for mining companies that operate across different Australian states. States such as NSW and QLD will generally find it easier to adopt the requirements. Currently, both NSW and QLD mining safety laws already require hazard management plans and safety management systems before mining can begin, WA mine safety legislation does not have such prerequisites or legislative requirements [10]. There have also been debates about the need for process-based standards. On one hand, proponents of such requirements have generally argue of inherent risks and hazards that mining poses on employees — necessitating a systematic approach to risk and hazards. On the other hand, some policy-makers have argued that, rather than being prescribed by regulations, such plans and systems should be at the discretion of the employer to consider and implement [10].Therefore, it is questionable whether the additional requirements in NSW and QLD are a source of unnecessary burden, or whether it leads to better safety outcomes compared with mining in WA. However, this does not mean these requirements do not have to be embraced, for they are necessary if the benefits of full harmonisation are to be realised in the future.

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