Emerging OHS Issues: "Over the Horizon"

Update of Mining Safety Research in the United States

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ABSTRACT

Mining safety research in the United States stems from an "umbrella" program, the National Occupational Research Agenda (NORA). It is a partnership program that has been operating since 1996 to stimulate innovative research and improved workplace practices. Industry sectors, such as mining, establish through consultation their own agenda for occupational safety and health research, inclusive of sector research strategic goals/objectives.

Besides broadly examining the US national safety research delivery model, this paper reviews the list of current strategic safety research goals for mining and explores a range of project developments driven through the US National Institute of Occupational Safety Health (NIOSH). This year NORA will renew the 2002 National Mine Safety Framework with the National Mining Agenda. This will be accompanied by a set of new objectives which offer an insight into the Australian mining industry's mining safety research priorities and emerging OHS issues in mining.

The paper critically examines Australia's approach to safety research with comparisons made against US models, then drills down to examine mining sector safety research in terms of strategy, priority-setting, research program support, and the eventual application of research outputs. While part of this paper does have a high-level focus, the primary intent is to provide practitioners and researchers with some guidance on how to align and inform their current and near future mine sites and mining industry occupational injury and illness prevention strategies.

Keywords: *Mining Safety Research, Emerging Issues, OHS Research Strategy, Australia, USA.*

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Introduction

The 1994 Queensland Mining Industry Health and Safety Conference[1] included a presentation on an Australian Coal Association Research Program (ACARP) – BHP Coal research project that investigated occupational health and safety research priorities for the Australian Black Coal Industry (Mitchell 1994). This research provided Australia's earliest large-scale scientific analysis to inform and prioritise OHS research for the industry. This was a significant departure from past research topic-setting that was based essentially on "gut-feel", "known research capability" or possibly, "vested interest".

Prior to 1990 Australia's mine safety research was essentially industry sector and state regulator driven. The last decade of the 20th century saw strategic developments in occupational health and safety research around the establishment of Australia's National Occupational Safety and Health Commission (NOSHC) and with evolution through the Australian Safety and Compensation Council (ASCC) to the present independent statutory agency Safe Work Australia (SWA). NOSHC is credited with formulating and delivering Australia's first national research strategy and program; this has since lapsed through changes in Australia's federal government. Currently Safe Work Australia (2012) lists the mining sector as one of several priority industry sectors for work health and safety management advancement through research and data analysis. Research is presently structured around commissioning, conducting and publishing research relating to work health and safety and workers' compensation in Australia (Safe Work Australia 2012).

On mining sector specific research, commencing in the early 2000s the Ministerial Council on Mineral and Petroleum Resources (MCMPR) initiated the National Mine Safety Framework (NMSF) aiming to achieve a nationally consistent occupational health and safety regime for the Australian mining industry (Department of Resources, Energy and Tourism 2012). MCMPR included a strategy within the framework for a collaborative approach to research.

The coal mining sector in particular has been involved in mine safety research in Australia (pre-dating NOSHC). Of particular note were ACARP and Coal Services (previously known as Joint Coal Board) Health and Safety Trust. More recently, the Mine Safety Advisory Council (MSAC) (2012) offered small research grants, however this program included research such as the "Digging Deeper" project (NSW Department of

[1] "Changing the Culture" Conference, 1994, Yeppoon.

Primary Industries 2007) which involved interpreting and converting research to industry action plans from the recommendations of the Wran Mine Safety Review (Wran 2005).

This paper asserts that there is adequate information to support the statement that the current state of play of mine safety research at the national level in Australia is inadequate. Safe Work Australia, despite identifying the mining sector for priority OHS intervention and also having national health and safety research strategy and delivery responsibilities, lists no mine safety research reports in its public collection. The entire mining industry resource set consists of a fact sheet, a guideline document, and current injury, fatality and workers' compensation data.

In 1997 the Queensland Mining Industry Health and Safety Conference followed the mine safety research theme with a presentation from the National Institute of Occupational Safety and Health (NIOSH) and the Pittsburgh Research Centre (Metzler 1997). The authors reported on the succession plan to transition mine safety research responsibilities to NIOSH (incorporating Pittsburgh and Spokane Research Centres) in response to a congress-directed restructure and closure of the US Bureau of Mines. The new research directorate was, at the time, recently installed in the Centres for Disease Control and Prevention. NIOSH had developed a progressive research strategy drawing on the organisation's strengths nurtured through a history of occupation health research, enhanced by the acquisition of engineering research know-how of the Pittsburgh and Spokane teams.

The changes in the delivery structure for mine safety research programs was underpinned by a strategy based around scientific identification of highest research priority needs. In the process, NIOSH brought together private and public sector partners to develop the National Occupational Research Agenda (NORA) which initially identified 21 research priorities (13 transgressing topics of mining sector safety) spanning three categories: Disease and Injury, Work Environment, and Workforce and Research Methods. Metzler and Tuchman's (1997) overview of the NIOSH strategy reinforced its key attributes as being: Focus on development of technology to prevent or minimise their impact on miners; Expanded coverage of health and safety research to the broader mining sector (not just coal); and, Continued emphasis on eliminating or reducing mine environment and mining process hazards.

This founding strategy (which was formed in 1996) has been the basis for the development and continuity of a comprehensive mine safety research program for the US, with flow-on consequential benefits to the rest of the world.

Mining Industry, Nation by Nation

Australia has a land area of 7.7 million km^2 and a population of 22.3 million with a crude death rate[2] of 6.4 per 1,000 people in 2010 (World Bank 2012). By sector, Industry (including resources and mining) accounts for 25.6% (2011 est.) of national nominal GDP (International Monetary Fund 2012). In 2008, the International Labour Organisation (ILO)

[2] From all causes: natural, accident, both non-work and work related etc.

(2012) estimated that 135,000[3] workers were engaged in the Mining and Quarrying sector in Australia indicating a labour-force increase of 48% since 2001 based on ILO data.

In comparison, the US has a land area of 9.1 million km^2 and a population of 309.3 million with a crude death rate[4] of 8.0 per 1,000 people in 2010 (World Bank 2012). By sector, Industry (including resources and mining) accounts for 22.1% (2011 est.) of national nominal GDP (International Monetary Fund 2012). In 2008, the International Labour Organisation (ILO) (2012) record that 845,000[5] workers were engaged in the Mining and Quarrying sector in USA indicating a labour-force increase of 36% since 2001 based on ILO data.

In trade exchange between the two countries, Australia imports 11.1% and exports 4.0% of annual total to USA (2010 est.); USA record their trade surplus of $US13 billion for 2010 as per cent of total trade being 1.2% to and 0.4% from Australia (US Department of Commerce 2012). The ILO estimate world nominal annual GDP (2011 est.) to be $US70 trillion and on this basis USA in total from all sectors contributes 22% and Australia in total from all sectors contributes 2%.

Table 1 compares relevant resource production data indices for the two countries.

Table 1 Resource production by country [After (British Geological Survey, 2012)]

Resource	Australia	USA
Coal	356 bt	1,067 bt
Gold	0.3 t	0.2 t
Copper	1.1 mt	0.8 mt
Crude Oil	24 mt	345 mt
Natural Gas	45 bm^3	611 bm^3

According to the ILO (2012), for the ten year period 1999 to 2008 fatal injury[6] rates in USA's mining sector reduced by 18% and by 68% for non-fatal injuries[7]. Australia for the same period reduced its fatal injury[8] rate for the mining sector by 67% and non-fatal injury[9] rate by 45%.

[3] Workforce demographic data used for international comparison (same reference). National datasets may carry greater accuracy; however the individual national data cannot carry the assurance of consistent methodology of determination between countries to enable international comparison.
[4] From all causes: natural, accident, both non-work and work related etc.
[5] See previous footnote.
[6] Work related cause.
[7] See previous footnote.
[8] See previous footnote.
[9] See previous footnote.

Mine Safety Research Projects in USA

In 1996 NIOSH established the National Occupational Research Agenda (NORA), a partnership program to stimulate innovative research into workplace safety. Government, academic/professional and industry partners collaborated to identify the most critical issues in workplace safety and health, and develop objectives and research programs to address research requirements. The following criteria are used to inform the program's priority setting process:

- Numbers of at risk workers
- Severity of the hazard or issue
- Probability that new information and approaches will make a difference

Operating for more than one and a half decades, NORA utilises an industry sector structure having a council assigned to each sector with their inputs formulating the national agenda for work health and safety research. Table 2 summarises NORA's ten industry sector councils to which NIOSH provides a facilitative and administrative role.

Table 2 NORA 10 Industry Sectors [After (NIOSH, 2012)]

NORA Industry Sector Councils
Agriculture, Forestry & Fishing
Construction
Healthcare & Social Assistance
Manufacturing
Mining (except Oil and Gas Extraction)
Oil and Gas Extraction
Public Safety
Services (except Public Safety)
Transportation, Warehousing & Utilities
Wholesale and Retail Trade

Sector Councils formulate programs (through agendas) that establish research priorities. NIOSH then funds research programs targeting change and improvement in work health and safety within the sector. The NORA Mining Sector Council has goals to:

- identify the most salient needs of the sector;
- facilitate the most important research;
- understand the most effective intervention strategies; and
- learn how to implement those strategies to achieve sustained improvements in workplace health and safety practice

The Draft Agenda for the Mining Sector Council (NORA Mining Sector Council 2012) provides the following vision statement:

> *Mine safety and health research will provide a workplace where miners will have their quality of life unimpaired by accidents or disease. Benchmarks for this vision will be progressive and continuously improving, having miners' occupational safety and health statistics better than any previous year in mining, setting the best practice world-wide, and with individual mine units – large or small – supporting the Vision.*

The proposed 2012 agenda consist of seven objectives covering:

1. Disaster Prevention (with three sub-project areas)
2. Disaster Response (with seven sub-project areas)
3. Health and Illness (with six sub-project areas)
4. Atmospheric Control and Ventilation (with seven sub-project areas)
5. Behavioural (with six sub-project areas)
6. Operations and Management (with 12 sub-project areas
7. Ergonomics also known as human factor engineering (with nine sub-project areas)

In total some fifty priority mine safety research areas are identified, most are also detailed to a further level of specific research objectives. Additionally, NIOSH has assembled a collection of almost 2,000 mineral and extractive industries safety research publications produced from their research programs. Figure 1 presents a breakdown of subject areas covered.

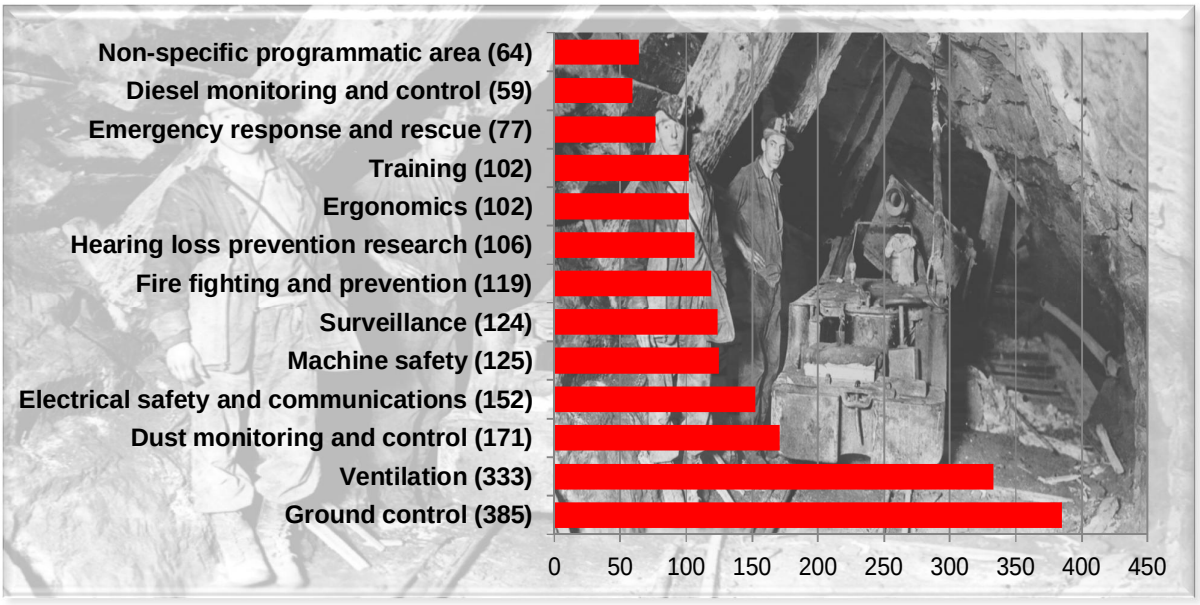

Figure 1. Distribution of NIOSH Mining Safety Research Publications by Topic [After (NIOSH 2012)]

Contained in the Non-Specified Program topics are some interesting mining health and safety topics including, but not limited to:

- Approved Explosion-Proof Coal-Cutting Equipment
- Chemical-Related Injuries and Illnesses in U.S. Mining
- Development of a Taxonomy for Web-based Mining Safety and Health Research
- A Guidance Sensor for Continuous Mine Haulage
- Haulage Truck Dump Site Safety: An Examination of Reported Injuries
- Possible Impact of New Safety Technology Developments on the Future of U.S. Industry
- Review of Recent Research on Organizational and Behavioural Factors in Mine Safety
- A Study of Heat Stress Exposures and Interventions for Mine Rescue Workers
- Devices to Monitor Blind Spots Near Large Haulage Equipment
- Workplace Stress

This year a further 27 mining safety research publications have been added to the collection. Table 3 presents the distribution of published work (2012) by topic, with the most prevalent topics this year to date being “Ventilation”, “Dust” and “Noise”. It is also encouraging to see that “Ergonomics” and “Health Surveillance” feature, however publication around “Diesel Emission” is noticeably absent.

Table 3 NIOSH Mining Safety Research Publications (for year 2012) by Topic [After (NIOSH 2012)]

Mining Research Topic	No.
Non-specific programmatic area	0
Diesel monitoring and control	0
Emergency response and rescue	2
Training	1
Ergonomics	2
Hearing loss prevention research	4
Fire fighting and prevention	3
Surveillance	3
Machine safety	1
Electrical safety and communications	0
Dust monitoring and control	4
Ventilation	4
Ground control	3

Additionally, NIOSH manages potential redundancy and replication of effort in work health and safety research with its Cross-Sector Research Program. There are 24 cross-sector research areas including:

- Authoritative Recommendations
- Cancer, Reproductive and Cardiovascular
- Communications and Information
- Economics
- Emergency Preparedness and Response
- Engineering Controls
- Exposure Assessment
- **Global Collaborations**
- Health Hazard Evaluation (HHE)
- Hearing Loss Prevention
- Immune and Dermal Diseases
- Musculoskeletal Disorders
- Nanotechnology
- Occupational Health Disparities
- Personal Protective Technology
- Prevention Through Design
- Radiation Dose Reconstruction
- Respiratory Diseases
- Small Business Assistance and Outreach
- Surveillance
- Total Worker Health
- Training Grants
- Traumatic Injury
- Work Organisation & Stress Disorders

NIOSH cross-sector programs are managed by steering committees to develop and deliver research and publication activities on contemporary and emerging research subjects around adverse health outcomes, statutory programs, and global health and safety improvement efforts.

Mine Safety Research Projects in Australia

While Australia's national health and safety research strategy has been applied on several occasions[10] with sporadic support for several mining sector safety research projects, the majority of mining research projects have been carried forward substantively by coal mining sector organisations, mining inspectorates and universities (as research and higher learning degree projects). Most prominent of these are ACARP (2012) with 334[11] mining safety and health related research projects and Coal Services Health and Safety Trust (2012) with 68[12] mining health research projects. Additionally, the Minerals Industry Safety and Health Centre (MISHC) (2012) based at The University of Queensland, have contributed 32[13] projects since 1996.

ACARP has been at the forefront of technical excellence and coal industry research since it was established in 1992. ACARP has led coal mining safety research in Australia to reduce risk of serious occupational health; environmental; and, social impact issues of mining. Mining health and safety research projects are considered on merit with the underlying requirement to support the coal mining sector.

Coal Services Health and Safety Trust was formed in 1991. The Trust's primary areas of interest are the occupational health and safety of coal mine workers in the Australian Coal Industry. The Trust has links with major research bodies in the Coal Industry. The priority areas for the Trust are: Injury; Disease; Human Factors; and, OHS Systems.

The MISHC was formed in late 1996 to initiate education and research into mine safety through the Sustainable Minerals Institute. Mining safety, as such, has not previously been recognised as an area of expertise within The University of Queensland, but has been included in response to specific issues in subjects offered by the Department of Mining, Minerals and Materials Engineering. The Centre was founded by the joint vision of seven mining companies, the State Government's mines departments and The University of Queensland.

These organisations are commended for their ongoing commitment to advancing health and safety for the mining sector through research within Australia. While there are some individual researchers collaborating internationally at project level, formal links between Australian mining safety research organisations are not apparent.

Strategy and coordination of health and safety research at a national level continues to lack definition and substance necessary to support and direct the industry sector research bodies and the greater nation.

Global Collaboration Opportunities

Of particular interest to the Australian Mining Industry is NIOSH's Global Collaboration Program (NIOSH 2012). The program is NIOSH's point of focus for its work with

[10] National Occupational Safety and Health Commission (NOSHC) and with evolution through the Australian Safety and Compensation Council (ASCC) to the present independent statutory agency Safe Work Australia (SWA).
[11] Based on broad bibliographical search on terms "Safety" or "Health" or "OHS" spanning all years.
[12] All recorded.
[13] ACARP and CSHST funded projects may be recorded in multiple databases.

international partners and research organisations. NIOSH has a stated goal to enhance global occupational safety and health via international collaboration. The program seeks to:

- Lead in developing a global network of occupational health centres
- Investigate alternative approaches through international learning, to reducing occupational illness and injury
- Provide technical assistance to put solutions in place
- Build global professional capacity to address occupational hazards through training, information sharing, and research experience

Within its Global Collaboration Program, NIOSH identifies eight emerging issues in work health and safety able to benefit from international collaboration in research. These include:

- **Nanotechnology** – *The manipulation of matter on a near-atomic scale to produce new structures, materials and devices.*
- **Control Banding** - *(simple guidance to control exposures) Control banding (CB) is a generic technique that determines a control measure (for example dilution ventilation, engineering controls, containment, etc.) based on a range or "band" of hazards (such as skin/eye irritant, very toxic, carcinogenic, etc.) and exposures (small, medium, large exposure).*
- **Avian (Bird) Flu** – *Avian influenza (or bird flu) is a poultry disease caused by viruses that normally infect birds. The first cases of human infection with the highly pathogenic avian influenza virus H5N1 occurred in 1997 in Hong Kong.*
- **Emergency Preparedness for Business** – *A comprehensive plan for dealing with terrorism-related events should include specific instructions to building occupants, actions to be taken by facility management, and first responder notification procedures.*
- **Stress at Work** – *Primary themes in the work stress research programs are:*
  1. *To better understand the influence of what are commonly-termed "work organisation" or "psychosocial" factors on stress, illness, and injury*
  2. *To identify ways to redesign jobs to create safer and healthier workplaces*
- **Musculoskeletal Disorders** - *Ergonomics is the scientific study of people at work. The goal of ergonomics is to reduce stress and eliminate injuries and disorders associated with the overuse of muscles, bad posture, and repeated tasks.*
- **Climate Change Effects on Workers (Thermal (Cold/Heat) Stress)** – *Workers who are exposed to extreme temperature or work in extreme temperature environments may be at risk of thermal stress.*
- **Green Jobs** – *There are benefits as well as challenges of moving to a green economy. Green jobs are being defined broadly as jobs that help to improve the environment. As part of the* ***Prevention through Design*** *(PtD)*[14] *initiative, NIOSH and its partners are developing a framework to create awareness, provide guidance, and address OHS issues associated with sustainability efforts.*

While the intent of the Global Collaboration Program's emerging research issues list clearly has "cross-sector" intent, it is equally clear that the emerging issues have relevance (be it to varying degrees) to the Australian Mining Industry health and safety research programs. Finally, NIOSH has an objective to develop and grow its

[14] Safety in Design per Australian WHS Legislative Requirement.

international collaboration and lists existing research partner relations and agreements with countries (NIOSH 2012) including:

- Canada
- South Africa
- Singapore
- Poland
- South Korea
- Germany
- France
- Finland
- United Kingdom

Australia, by nation and by research organisation or institution is distinctly absent from NIOSH's Global Health and Safety Research partnership network.

Conclusion

Australia is a big country, *"...We've golden soil and wealth for toil; Our home is girt by sea"* [15]. Our "wealth for toil" through our natural resources industries and geared into a grossly smaller population generally provides Australian's with a significantly better life than our USA counterparts measured by crude life expectancy and death rates per year indices. We share roughly the same geographic size as USA; however that's about where the comparative equivalence stops. Our mining industry workforce, while growing at a faster rate than USA, is only around 16% the size. Our contribution to nominal global GDP is only 10% of the USA which annually adds about one-fifth of the global total.

In 1994, the findings of the Commissioned Study of Occupational Health and Safety in the Australian Coal Industry (Mitchell 1994) were presented to this same forum. It was ground breaking research drawing on about 30,000 workers compensation records and review of bibliographic databases. The research was able to add some science to setting priorities for Australian mining safety research which at the time was low, about 10% of the USA. Recommendations were also presented urging the industry to change, with specific recommendations on research priorities, research funding, considering emerging issues, stakeholder collaboration, publication, and research strategy not dissimilar to the NORA model. Almost 20 years on, the Australian mining industry's safety research program and approach is little different.

In 1997, we heard of significant change in USA regarding mining safety research. In comparison, NIOSH over the same timeframe have seized an opportunity to build an enduring and productive research strategy and delivery platform.

While the Australian mining industry has maintained its journey of rapid medium term growth, mining safety research in Australia has not shared the same ride. It is apparent that as a nation in the global mining industry sector Australia continues to be impacted by the notion of *"...girt by sea"* when it comes to mining safety research. It's a fallacy that such isolation has limited Australia to undertaking token mining safety research "in our own back-yard" when programs such as NIOSH Global Collaboration has been operating for a number of years offering opportunity for Australia to join the partnership.

Australia has the ability to share its wealth of mining safety research innovation and gain significant value in return through global collaboration.

Ability is of little account without opportunity. ~ Napoleon

[15] With apologies to the honour and sentiment of the Australian National Anthem, *Advance Australia Fair*.

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