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OHS IN THE MINING INDUSTRY IN THE 21ST CENTURY

David Cliff

Abstract: As the 21st century progresses serious questions are being asked of the capacity of the minerals industry to maintain or improve its Occupational Health and Safety (OHS) performance. The pressures on mining and mineral processing will come from many directions. Cost pressures are only going to increase; societal acceptance of mining may well become harder to obtain and mining and mineral processing conditions will probably get worse as lower quality ore bodies have to be mined at deeper depths. This in turn places pressure on OHS; in the developed world there will be smaller work forces operating more autonomous machines. Fewer people, lower exposure and therefore less risk? Not necessarily, as the danger of low manning levels is that the knowledge and awareness of the risks also diminishes. As incidents become less frequent, the awareness of them and their potential for harm reduces, actually increasing the risk of harm. In the developing world, due to low labour costs, ongoing unemployment issues and in many cases less rigorous legislative requirements, there will undoubtedly be an increase in small scale and artisanal mining, as well as the development of large scale mines. Here the potential for harm is due to the total lack of awareness of OHS issues at all levels in the industry and the lack of regulatory capacity to promote and enforce a safe and healthy workplace.

INTRODUCTION

Within the developed world great progress has been made in reducing accidents and incidents in the mining industry. Large highly mechanised mines, employing relatively small workforces, have achieved significant reductions in frequency rates. Australian mines are a good example of this. Figure 1 shows the Fatal Injury Frequency Rate (FIFR) (deaths per million working hours) since 1989. For convert to per 1000 workers simply multiply by 2, as the average Australian miner works about 2000 hours per year. Going back further would show even higher fatality rates.

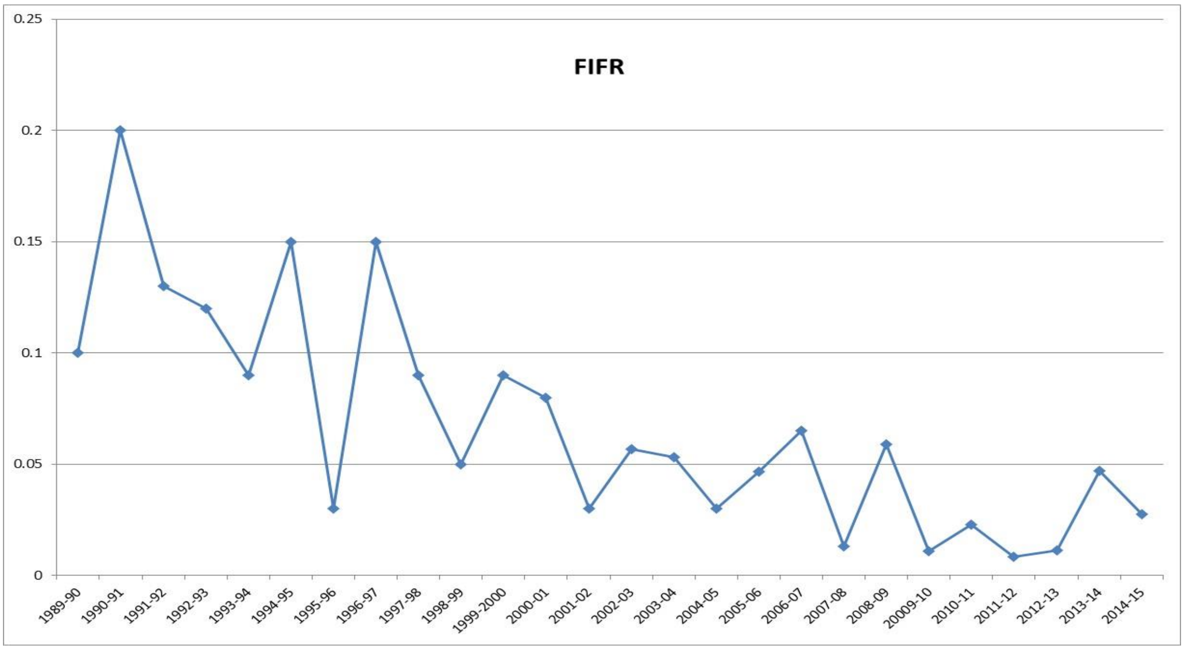

Figure 1: Fatal Injury Frequency Rate for Australian Mining since 1989

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The risks posed vary with the type of mining. Figure 2 depicts a comparison between the major mining sectors over a ten year period for a number of countries. In addition the risks have changed over time. Historically principal hazards such as fire, explosion, outburst, rockburst and fall of ground have been the major cause of fatalities. These hazards are generally well managed today and the focus has shifted to incidents that cause individual rather than multiple fatalities as shown in Figure 3.

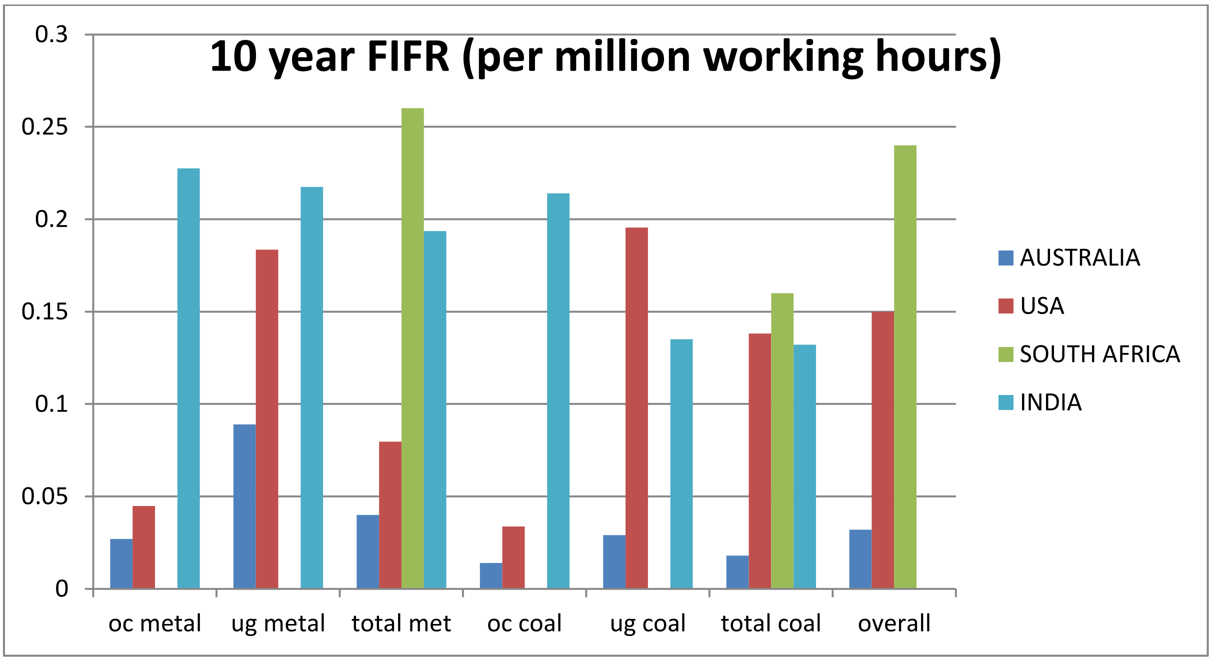

Figure 2: 10 year FIFR by sector

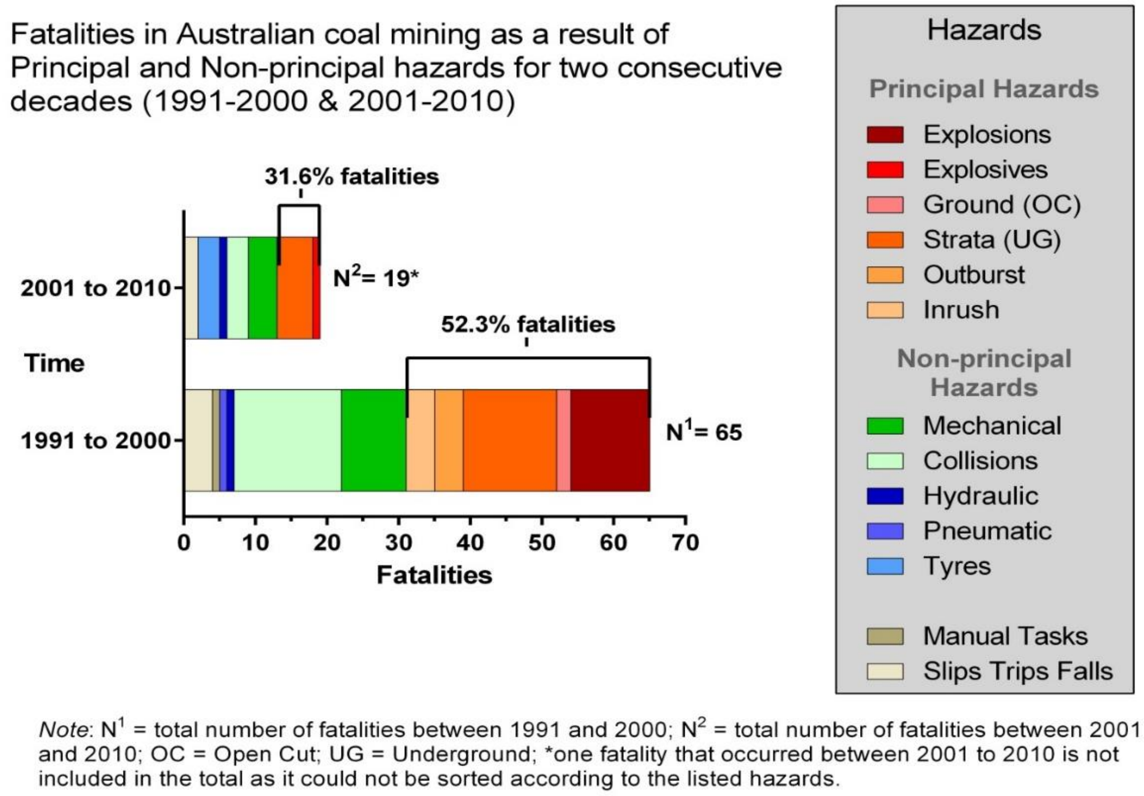

Figure 3: The change in the nature of fatalities in Australian coal mines over the past 20 years (Kirsch *et al.*, 2014)

In Australian mines, most fatalities over the past 10 years, with the exception of rock falls, have involved plant or equipment in some way (figure 4).

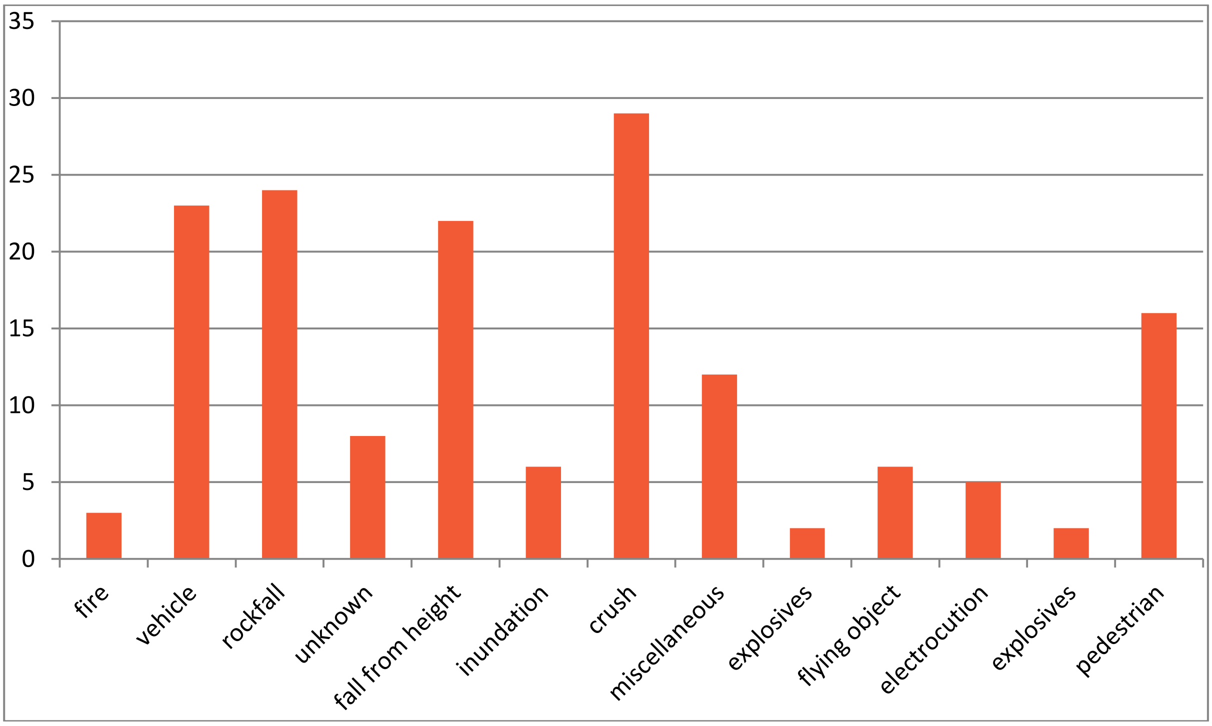

Figure 4: The number and type of fatal accidents in Australian mines over the past 10 years

The fatality curve shown in Figure 1 is typically aligned with changes in safety culture as shown in Figure 5 and the reduction in rates is due to the progressive implementation of technology, systems and culture (or a people focus) as shown in Figure 6. Technology continues to develop with the introduction of autonomous vehicles and the widespread use of remote control equipment.

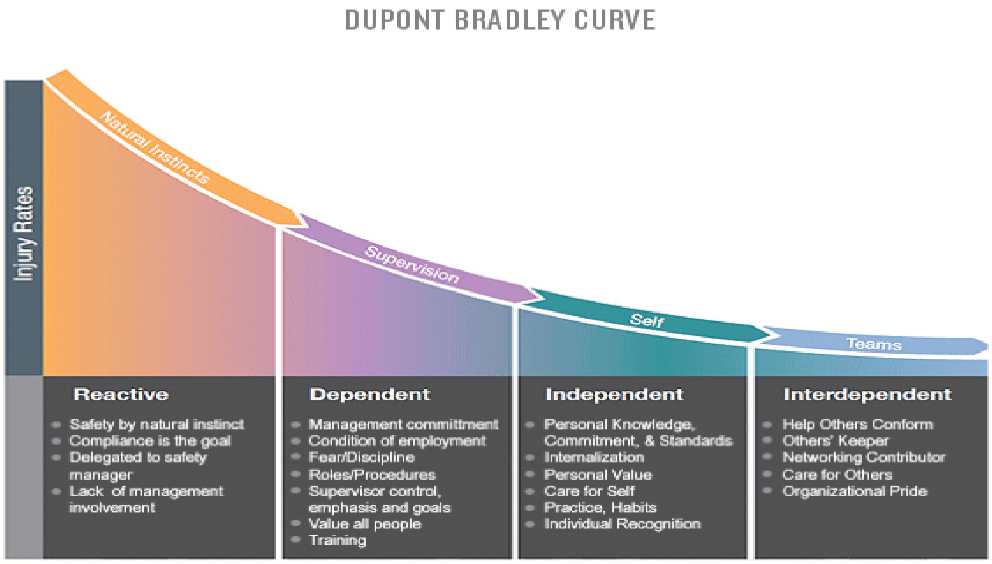

Figure 5: The Bradley Curve (Dupont 2015)

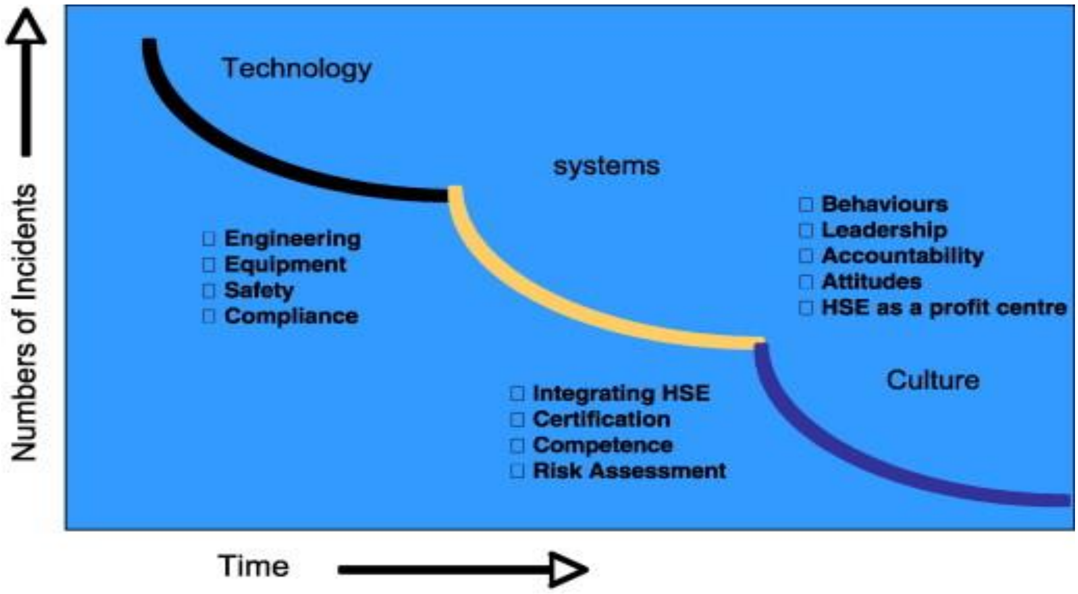

Figure 6: The Hudson Safety development line (Hudson 2007)

THE FUTURE

There is no doubt that through the implementation of technology and through gaining an understanding of major mining hazards, the incidence of multiple fatalities has been reduced. The last fire or explosion in an underground coal mine that caused fatalities was in 1994. Australia went over 10 years without a multiple fatality event (2000 to 2013).

The implementation of safety management systems, risk management, work force representation and duty of care and process based legislation have been credited with making Australian mining the safest in the world.

Sophisticated incident investigation techniques that allow investigators to drill down to the underlying causes have assisted in developing safe systems of work. These underlying causes do not always rely on an error by the person who was harmed. The importance of external factors such as the organisational culture, the work environment, the physical environment and the actions or inactions of others have now been recognised.

Huge strides have been made in improving health and safety performance by shifting from compliance with legislation to management with best practice standards.

The current low commodity prices place immense pressure on mines to improve productivity and reduce staffing. This in turn can lead to a reversal of the safety culture improvement through the focus on doing what has to be done rather than what should be done. Brown *et al.,* (2000), while exploring safe employee behaviour in the steel industry, found that during times of increased production, employees felt that the need to meet production quotas abated safety procedures, and that their bonuses and jobs may be placed in jeopardy if they were to follow these procedures.

Technology, systems and culture all require continual effort and adequate resourcing to be effective. Reducing the effort or resourcing risks increasing the health and safety risk. Success is its own worst enemy. The low fatality rate breeds complacency, and the assumption that the hazards are not real as miners have not experienced them themselves. This in turn leads to the underestimating of risk and therefore reducing the need for controls. In the past two years in Australia there have been a spate of fatalities and the rate is much higher than for the previous four years, this may just be coincidence or a warning of things to come. The Pike River Coal Mine disaster where 29 miners lost their lives in 2010 (Royal Commission 2012), is seen as a classic example of failing to recognise the hazards. With limited resources there is a tendency to retreat to rules and compliance, compliance of course aims to ensure a minimum standard not best practise. This would suggest a reversion in safety culture to earlier more basic levels. There is a need for companies to reassert their commitment to the health and safety of workers and ensure that no corners are cut.

Effective safety and health management systems require continual vigilance to ensure that the systems are being implemented as designed and are achieving the desired outcomes. This monitoring and review process requires personnel, resources and management commitment. The focus needs to be on the effectiveness of controls not just having controls. Sometimes there are too many controls and it can be better to focus on a few critical controls that are effectively implemented Hassall *et al.,* 2015).

New technology will be introduced to improve mining and mineral processing, but unless how it works is properly understood, there is the danger of creating new risks not from malfunctioning systems but from complex systems functioning as designed, just not as predicted (Dekker 2011). An example of this is the recent accident between an autonomous haul truck and a water cart. The autonomous haul truck performed as it was programmed, however the driver of the water cart was not aware that the vehicle was about to turn across its path (Latimer 2015). The "Human Error" was not by the driver of the water cart but more likely by the people responsible for the design and implementation of the autonomous trucks and the need to coexist with manually driven vehicles.

To avoid this we need to focus on the right hand side of the safety culture diagram shown in Figure 5 and recognise that the workforce is an asset that needs to be nurtured. Now more than ever the old mantra of a safe workforce is a productive workforce is true. Fiedler back in 1984, (Fiedler et al, 1984) demonstrated that working on productivity and safety cooperatively improved both. All those attributes listed under the Independent and Interdependent categories are not exclusive to OH and S. They apply equally to effective production. McLain and Jarrell investigated the outcomes of compatibility between safety and production. In line with theory, this research suggested that safety-production compatibility (and thus conflict) was linked to safe work behaviours and the extent to which hazards interfered with tasks performed (McLain and Jarrell 2007).

The financial benefits of good OHS performance are well documented. The costs include not only the direct costs but also the hidden costs which can be up to 200 % of the direct costs (Oxenburgh 1991). Thus it would be argued that reducing accidents and illness makes good financial as well as ideological sense. It is not just time away from work that reduces productivity but also presenteeism – where one is at work but not functioning at full capacity, also reduces productivity. Williden *et al.,* (2012) showed that workers affected by stress and anxiety whilst still at work, have reduced productivity by over 10 %. Presenteeism can multiply the real cost of an illness by up to four times (Geotzel *et al.,* 2004).

As well as causing illness and lost productivity, work stress has also been shown to influence employee safety through a number of mechanisms. Masia and Pienaar (2011) found that work stress had an inverse relationship with safety compliance, as they did for job insecurity. In addition, several studies by Maiti and colleagues have suggested that job stress encourages employees to avoid safe work behaviours, thus increasing their likelihood of workplace injuries, and that job stress can indirectly lead to employees becoming less job-involved, which may also increase their likelihood of injury as greater job involvement is associated with better safety performance (Maiti 2004; Paul and Maiti 2008). In the same studies, Maiti and colleagues also suggested associations between safe work behaviours and negatively personified individuals, suggesting that these individuals not only fail to avoid work injuries, but that they are also unable to extend safe work behaviours in their work but instead engage in risk-taking behaviours, all of which makes them more susceptible to workplace injuries (Maiti *et al.,* 2004; Paul and Maiti 2008).

The level of stress in professional staff must increase as their number decrease. There will be fewer of them, particularly in support roles, to cope with all necessary tasks and responsibility. This may lead to high turnover of key roles and loss of corporate memory. Time pressures may cause tasks to be done quickly rather than completely. Risk assessments are in danger of becoming paper exercises rather than real assessments of risk.

These stressors are worse when we consider the other world of mining prevalent in developing countries –Small Scale and Artisanal Mining (SSAM). This type of mining is already characterised by generally poor technology, no systems and poor culture. It is mining to survive. It is difficult to know how many people die, are injured or suffer ill health each year in SSAM as no statistics are gathered for what is informal and often illegal mining. This kind of mining is likely to increase in scale as the world population increases and more and more people scramble to survive. Small-Scale and Artisanal Mining occurs in approximately 80 countries worldwide. The sheer scale and transient nature of the mining makes it difficult for governments to manage, especially those who are poor. Artisanal and small-scale production supply accounts for 80% of global sapphire, 20% of gold mining and up to 20% of diamond mining (World Bank 2013). It is widespread in developing countries in Africa, Asia, Oceania, and Central and South America. Though the informal nature and on the whole un-mechanized operation generally results in low productivity, the sector represents an important livelihood and income source for the poverty affected local population. It ensures the existence for millions of families in rural areas of developing countries. About 100 million people – workers and their families - depend on artisanal mining compared to about 7 million people worldwide in industrial mining (World Bank 2013). Landslides are common; the use of toxic chemicals, such as mercury, is widespread; and women and children are often pressed into service in the most menial and dangerous roles (Navch *et al.,* 2006). Mining and mineral processing often occur in and around communities exposing not only the workers but their families to the hazards. Whilst there has been a concerted effort to remove mercury from gold processing in SSAM, the primary aim of the program is the reduction in environmental harm rather than the harm to the miners. There is a need for a concerted effort to improve the health and safety of SSAM miners through educating them in the risks and the controls, provision of support and equipment and encouragement to use safer techniques. It is also vital that this type of mining is recognised and legitimised. Governments must exercise a much greater role in facilitating the health and safety of artisanal miners. Wealthy countries need to support activities in these countries aimed at improving OHS and the quality of life.

CONCLUSIONS

The 21st century poses many challenges to improving the health and safety performance of the world-wide mining community.

In some ways the recent success in reducing the fatality rate in mining in developed countries is its own worst enemy as it can breed complacency. Couple this with the pressures to reduce cost and improve productivity and there is a real danger that the health and safety performance in developed countries will get worse rather than better. It is essential that we fully understand how new technology works and the full implications of its operation.

For the developing world the situation is potentially grimmer with increased pressure from a rapidly growing population merely seeking to survive, not able to afford the niceties of safety equipment or good work practices.

Both worlds will be impacted by low commodity prices leaving less money to spend on discretionary items. The challenge is to not make good health and safety optional but compulsory a normal part of the way of life.

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