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# Taking Stock of Safety

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# Taking Stock of Safety

G L McDonald<sup>1</sup>

## ABSTRACT

My early experience with the coal industry was in the latter half of the 1970s, where attention to only ones own 'accidents' and concentration on behaviour controls were impeding the introduction of effective engineering controls such as ROPS, FOPS, roof support and residual current devices. Lack of the broad picture of personal damage and of relevant veridical (true saying) knowledge and data had to be overcome to achieve progress in reducing fatalities. Thirty years on, it is again necessary to take stock. How good is our knowledge, our data, our information on which we make decisions. Despite Australian all industry 1992-93 data showing 80.5 per cent of costs came from occurrences which permanently altered people's lives, New South Wales is still the only state reporting permanent disabilities. In 1991 - 1992, the rate of permanent disability per 1000 wage and salary earners was two. In 2000 - 2001, it was over four - more than doubled. Also strongly motivating is the huge cost. Industry carried 25 per cent of the \$34.3 billion costs for 2000 - 2001, up ten per cent of 82.8 billion if the costs of pain, suffering and early death are included.

## INTRODUCTION

Community, industry, corporate and individual memory dim with time so that valuable knowledge and experience disappear and becomes unavailable. Stories help consolidate memory and make available lessons from the past. This in many ways is my story as a safety consultant for 30 years. In part it is the story of aspects of corporations; it began and was shaped in the coal industry, spread through other industries to finally contemplate the whole of Australian industry.

The quest, first dimly felt and later crystallised was the minimisation of the permanent alteration of people's lives which accounts for 82 per cent of the total cost of personal damage from work. If pain, suffering and early death were costed in it would go over 90 per cent of total costs.

## ROLLOVER PROTECTIVE STRUCTURES

Fresh from research on tractor 'accidents', study of mechanical engineering and psychology, and with a background of tractor driving, I was called by UTAH to Goonyella to investigate the overturning death of their most skilled front end loader operator while loading coal into a haul unit in the mid 1970s. By then rollover protective structures (ROPS) had over 15 years of established effectiveness of saving tractor drivers' lives, since 1958 in Sweden. Mining folklore was strong. 'Drop the bucket' was the conventional wisdom to stop a front end loader overturning while 'when in doubt, right hand out' (drops the bowl) was the saying which guided scraper drivers for emergencies. These strongly held beliefs left the operators confident and secure while they continued to be exposed to death.

UTAH responded rapidly to recommendations to fit all earth moving equipment with rollover protective structures (ROPS). Other coal mining companies did not. They had not had rollover fatalities. Two more operators were to die before the Mines Department asked me to give evidence to have wheel dozers replaced by track dozers on low profile stockpiles. The latter operator had reversed over a freshly undercut stockpile edge at

night under poor light conditions. As long as it had a ROPS I did not care whether they had tracks or wheels. The Mining Warden's finding resulted in compulsory ROPS for surface mines. Underground and metalliferous mines, quarries, road construction and dam construction were still many years away from ROPS. A much more recent mining death in Western Australia arose from using a posthole digging tractor old enough to escape a legislated ROPS. Throughout Australia there are still many tractors and tractor derivatives operating without ROPS. A belief in 'human error' causation and a belief that only the organisation's experience was relevant delayed progress.

## CLUTHA EXPERIENCE

In the late 1970s Clutha operated a number of underground coal mines in New South Wales. They had developed a safety program and needed a 'motivator' to get it to work. They had a lost time injury frequency rate (LTIFR) well up in the hundreds and over the past ten to 15 years had had nearly 30 fatalities, half from roof falls and half with machinery. Their safety target for the next year was a LTIFR of zero. This target was unrealistic and strongly indicated a lack of understanding. A great deal of underground work was under unsupported roof. They relied on riving the roof (striking the sandstone roof with a metal rod). When asked by moving my hands apart vertically what thickness of sandstone was required to give a clear metallic ring rather than a thud, the group stopped the hands at about ten inches (250 mm). When given the proposition that a clear ring meant that either there was a good roof or that when a fall came it would be a big one, the group replied 'it's always the good roof that kills you'. More folklore.

## THE FOLKLORE HURDLE

Experience showed that destroying a person's belief in the folklore without supplying a positive alternative provoked considerable anger. Convincing an operator that 'dropping the bucket' was not a reliable method of stopping overturning and then requiring the person to operate the machine without a ROPS was unacceptable. Anxiety is a difficult emotion to deal with and high anxiety levels can severely adversely affect a person's performance. It was found that a person generally would not relinquish their belief in their particular folklore until the need for it to convince them they were not vulnerable no longer existed. For many years nurses were strongly trained in 'correct' methods of lifting. This training made them psychologically comfortable while they overloaded and permanently damaged their bodies, mainly the spine in the lower back. A ban on the manual lifting of patients has dramatically reduced such damage. The belief in the folklore of 'correct' lifting had guaranteed that nurses continued to expose themselves to the probability of severe damage.

There is an element of truth in folklore, but it is a limited truth. Each work group would laugh heartily at other industry folklore but became disturbed and uncomfortable when their own beliefs were challenged. When one group was asked to identify their folklore, a supervisor summed it up well when he said:

*whatever our folklore is we believe they are truths.  
Someone from outside, who does not need to  
believe them, has to recognise our folklore for us.*

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## COOPERATIVE APPROACH

The coal industry has moved a long way from those relatively recent times. It is not always known or remembered what has been effective. In 1978 UTAH's Blackwater Mine imported the first of Euclid's short wheel base 120 tonne prime mover to haul coal. The machine was stood down and operators refused to drive it. The importers asked for an evaluation of the ride to determine whether there was a problem with the prime mover or whether they were caught in a union-management disagreement. Both a ride in the unit and measurement of its ride vibration confirmed it as too rough to be driven. When the manufacturer was unable to modify the ride, the union and management agreed that the unit should not be put into service. This cooperation meant an unknown number of Australian miners have been saved from permanent alteration of their lives.

In early 1996 contact from the United States of America revealed that a number of these units had been sold into 'green field' sites where the operators (sons of local farmers) had no haul driving experience for comparison. A large number of operators suffered vertebral end-plate fracture in the thoracic spine and in some, damage continued into the lumbar spine. The unit 'loped' or 'pitched' with the vibration varying from 40° to 50° to the horizontal. The horizontal accelerations equalled the vertical. To stabilise the spine the back muscles operating at a very shallow angle to the spine had to use maximum or near maximum contraction to prevent the upper body rotating forward over the pelvis. This strong contraction placed excessive compression loads in the spine which led to the damage.

## SLOW ADOPTION OF EFFECTIVE ENGINEERING INNOVATION

During this era a sad chapter in Australian safety history was being played out. Australia was largely oblivious. In 1969, this author had an earth leakage circuit breaker (ELCB) fitted to all circuits of his house being built. In the same year a Japanese labour safety and health regulation required the fitment of 'differential current operated protective devices' in the manufacturing industries. In that year (1969) there were 39 deaths, by 1972 there were 18, in 1980 there was one (Whiteman, 1987).

During this time Australian authorities, including Standards Australia, were working strongly on 'rules' which everyone concerned had to follow. Consulting to a Regional Electricity Board in the early 1980s led to the insight that authorities were worried that fitment of ELCBs would encourage people to be less careful, ie not follow the rules as well. It was many more years before there was strong encouragement to fit ELCBs. Rules had more influence on what was done than did the knowledge of the devices effectiveness in Japan.

## EXAMINING THE EVIDENCE

Taxonomic classification of past damaging occurrences according to types of energy used was developed in the coal industry and its application in the petrochemical industry produced new understanding. Records of 1037 cases of personal damage in one organisation showed when by reporting to an American standard, 9919 days had been lost over several years. At least 803 cases had no lost time, fewer than 232 cases accounted for 919 days and two cases resulted in 9000 days. The American standard charged 6000 days for a fatality and 3000 days for a paraplegic. If these two cases were removed, none of the remaining 1035 cases predicted the likelihood of the permanently life altering occurrences.

The next two organisations consulted were in the steel industry and produced similar results. The taxonomy of 'in house' experience of these three work sites predicted well for ten per cent of the damage but did not predict 90 per cent of the damage which came from very few occurrences.

Examination of reports from New South Wales WorkCover, the Queensland Workers Compensation Board and the American Coal Industry confirmed that the greatest quantity of damage came from a small number of occurrences.

Information on how lives were permanently altered was in very short supply. There was some information available on fatality but negligible information was available on how people became permanently disabled. Providing expert evidence to courts on litigation cases is a key avenue for learning in sufficient detail how people were damaged. Around 6500 cases are now on file at Geoff McDonald and Associates. An alternative approach was used by Ham (2003) who examined 267 cases of death and total permanent disability extracted from early claims on the Queensland Coal and Oil Shale Superannuation Fund (QCOS).

The Industry Commission (1995), part of the Commonwealth Department of Treasury reported on Work Health and Safety. While reporting on the costs associated with injury, they also concluded that their figures grossly underestimated the cost of occupational disease, which was significantly under-reported. The Report gave a costing of personal damage for 1992 - 1993. McDonald (1995) used these costings as a basis for estimating the proportion of cost for three classes of damage. Class I damage occurs if the person's life is permanently altered, Class II if it is temporarily altered and Class III if it is inconvenienced.

- 87 per cent of occurrences were Class II and gave 18 per cent of costs; and
- 13 per cent of occurrences were Class I and gave 82 per cent of costs.

This confirmed the view already formed that health and safety at work is fundamentally a Class I problem. Class I fatal accounted for 1.5 per cent of total cost. Class I non-fatal accounted for 80.5 per cent of total cost. Pain, suffering and early death were not costed in this exercise.

Effort over the years to focus attention on Class I non-fatal occurrences has been singularly unsuccessful. Despite the Industry Commission's 1995 report, New South Wales is still the only state reporting permanent disabilities. All other states are unaccountable for 80 per cent of the total cost of damage to members of the community on whose behalf they are required to manage work health and safety.

The National Occupational Health and Safety Commission (2002) (NOHSC) set ten year targets as follows:

*sustain a significant, continual reduction in the incidence of work-related fatalities with a reduction of at least 20 per cent by 30 June 2012. (and with a reduction of ten per cent being achieved by 30 June 2007), and ... reduce the incidence of workplace injury by at least 40 per cent by 30 June 2012 (with a reduction of 20 per cent being achieved by 30 June 2007).*

No mention is made of reducing cases which permanently alter people's lives non-fatally, ie those cases which account for 80.5 per cent of the cost in 1992 - 1993.

To examine change over recent years, it is necessary to look to New South Wales WorkCover since they are the only source which includes information on permanent disability. New South Wales WorkCover figures have been plotted and lines of regression calculated for the years 1991 - 1992 to 2000 - 2001. From the line of regression 'all occurrences' have declined from 28 per 1000 wage and salary earners in 1991 - 1992 to 22 in 2000 - 2001, a ten year change rate (decrease) of 22.7 per cent as shown in Figure 1.

By contrast, as shown in Figure 2, 'permanent injury' has increased from two per 1000 wage and salary earners in 1991 - 1992 to around 4.4 in 2000 - 2001. The rate of change is equivalent to an increase of 140 per cent over a ten year period.

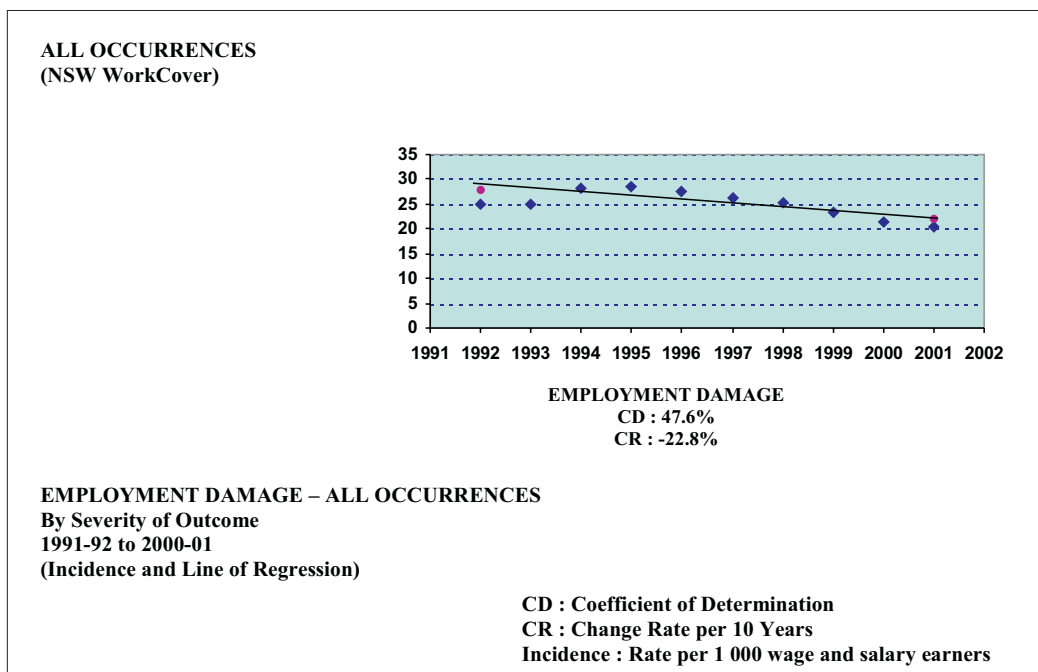


FIG 1 - Employment damage – all occurrences.

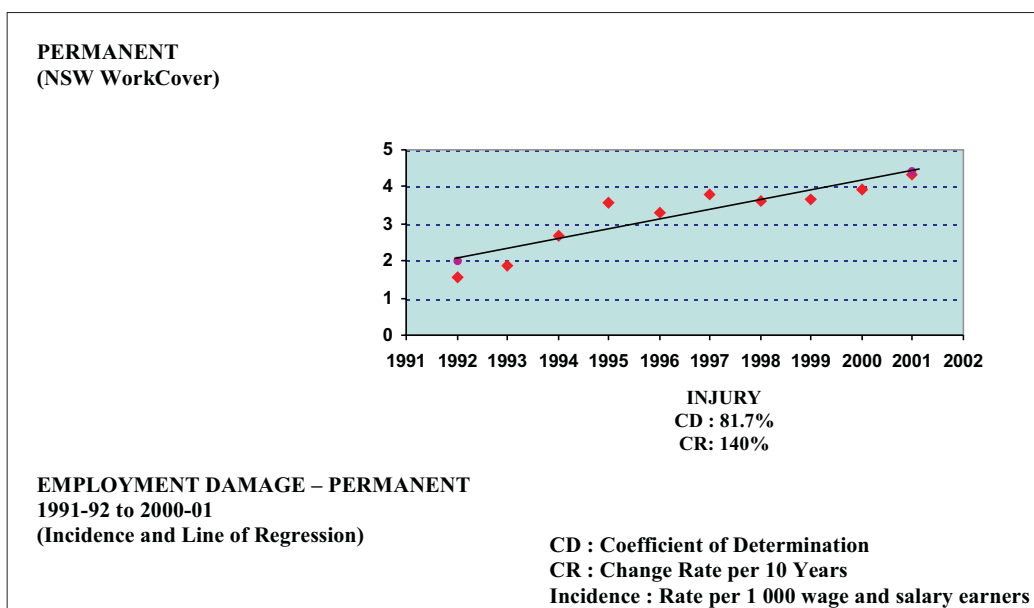


FIG 2 - Employment damage – permanent.

On the basis of these figures, the national targets set by NOHSC could be met, indicating desirable progress had been made when the quantity of damage had actually increased.

Further confirmation of the increasing quantity of damage in the Class I region comes from the National Occupational Health and Safety Commission's (2004) updating of costs of work related injury and illness to the year 2000 - 2001. Whereas 82 per cent of costs in 1992 - 1993 came from 13 per cent of occurrences, 92 per cent of costs came from 15 per cent of occurrences in 2000 - 2001. Again these costs do not include a consideration for pain, suffering and early death and totalled \$34.3 billion. A further costing for pain, suffering and early death was made and brought the total cost from work damage to people to \$82.8 billion. When the cost of pain, suffering and early death is included, 15 per cent of occurrences account for 96.5 per cent of costs.

This is powerful and surely irrefutable evidence that effort must be directed to the top end of the severity scale – Class I damage.

McDonald E L (1997) produced a taxonomy, 'Accidents in the Coal Mining Industry 1990 - 1995' for the New South Wales Minerals Council and the Queensland Mining Council. This sought to describe the origins of Class I damage but functionally had to settle for dealing with cases where greater than 90 days work was lost and fatalities. Eight hundred and ninety two underground mining and 312 open cut mining cases were classified according to the type of energy. For all coal mining human (39.8), gravitational (32.3) and machine (20.6) accounted for 92.7 per cent of occurrences, while human (38), gravitational (34.7) and machine (22.09) accounted for 94.8 per cent of costs.

Careful study of the taxonomy gives interesting insight. In considering open cut mining, combining a number of different taxa gives a picture of 'ride disturbance' which accounted for 27 per cent of occurrences and 49 per cent of cost. Figure 3 shows 74 cases occurred while the vehicle was moving and most involved vibration and jarring, with four coming from the operator impacting the vehicle interior. The 'stationary' cases mostly involved loading. This taxonomy provides a platform for a more detailed assessment which would identify such problems as mismatching of the ride characteristics of a machine and of the vibration isolation characteristics of the installed seat, as well as operational problems.

Over recent years attention has been directed to the Australia wide problem. Each day in 1992 - 1993, 137 people working in Australia had their life permanently altered by damage from work - 50 000 people a year. Of these approximately 20 000 will never work again and 30 000 work for fewer hours or on less skilled work. By now many more people per day will have their lives permanently altered. A nation cannot afford this loss.

If the late 1970s early 1980s experience with the coal and other industries is interrogated, it shows specific issues related to death were identified, specific solutions were developed and adopted. This occurred within a framework of the development of a new understanding and resulted in the gradual rejection of only partially true folklore. Its anxiety managing influence became unnecessary. WorkCover (1998 - 1999 - 2000 - 2001) shows that the three largest defined groups 'manual handling' 35 per cent, 'Falls to the same level' 23 per cent and 'falls from height' 11 per cent account for almost 60 per cent of cases. This appears different from human (39.8), gravitational (32.3) and machine (20.6) for McDonald's coal taxonomy until it is realised that the vast majority of WorkCover 15 per cent 'other' involves motor vehicles. On this basis the WorkCover data can be

referenced human (35), gravitational (24) and machine (15). Other cases would fit into these three groups so that the overall energy sources would be similar to that of the coal taxonomy. In many cases, however, the details of what happened in each case will be vastly different. It is knowledge of this specific detail which is critical, not only of individual cases but also of aggregated similar cases, to show clearly 'common pattern' and 'individual differences' so that specific countermeasures can be developed on the basis of veridical (true saying) knowledge.

### THE SAFETY PARADOX

The safety paradox must be confronted. On the one hand there are far too many Class I occurrences, on the other hand each specific type of Class I damaging occurrence is so rare that an individual who has to make safety judgements has no experience (first, second or third hand) or knowledge of them. They may well know the applicable folklore. Millions of person years of experience have to be aggregated to compile the appropriate detailed knowledge. The coal taxonomy was a start to aggregating and presenting information. It needs to develop further and grow on a continuous basis.

Our governments have the responsibility of managing work health and safety on behalf of the community they represent. They have adopted Robens style legislation which strongly requires management-workforce consultation and appears to assume the workforce knows what is required. In many cases they do not. The knowledge of what is required is embedded in the 137 a day (50 000 a year) cases of permanent life alteration. Sufficiently detailed case histories of these cases have to be aggregated, taxonomised, dissected and digested so that appropriate knowledge can be educated back to the workplace. While it is not clear who could most effectively do this, it is clear

#### Taxonomy of Ride Disturbance

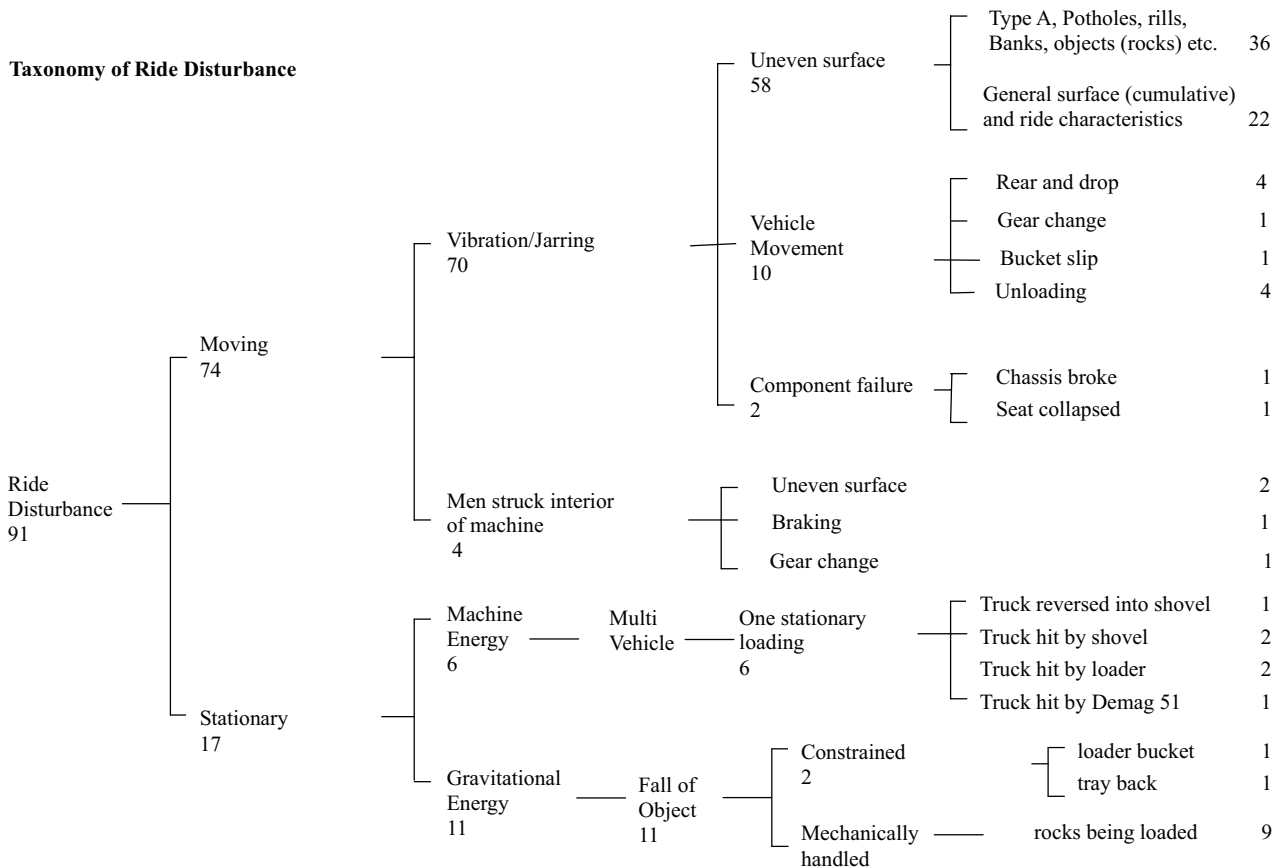


FIG 3 - Taxonomy of ride disturbance.



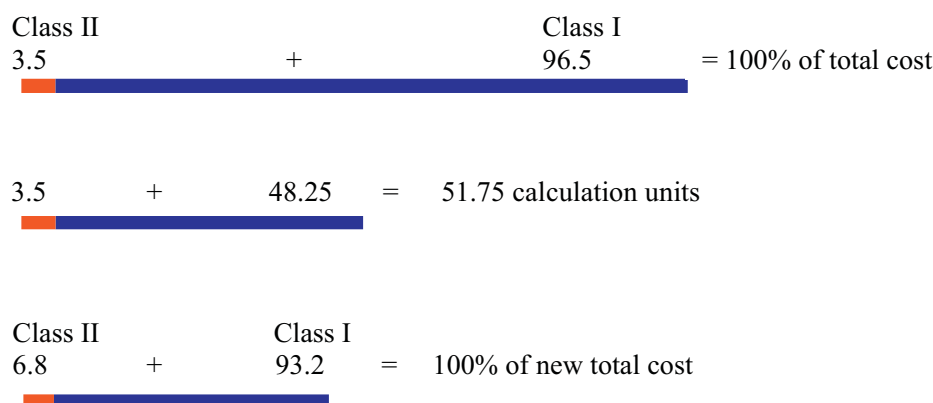


FIG 4 - Effect of halving Class I cost on proportion of cost.

that it is the government’s responsibility to see that it is done so that safety is not directed by lack of knowledge and by risk assessment necessarily based on the ‘feeling function’, as information is not available to enable the ‘thinking function’ to be used.

Within governments the safety function is under funded, with funds coming from industry and not from community generated money. According to NOHSC (2004), if pain, suffering and early death are not included in costing, the employer carries 25 per cent of the cost. Therefore the individual and the community carry 75 per cent of the cost. If pain, suffering and early death are included the employer carries 12 per cent and the individual and the community carry 88 per cent of the cost. The community has far more to gain by a reduction in Class I damage than does the employer. The employer has much to gain as better quality information gives more efficient and effective control effort.

Earlier it was stated that the total cost of work personal damage for 2000 - 2001 was \$34.2 billion without pain, suffering and early death being costed and \$88.2 billion if it was. By way of illustrating the size of that amount it is noted that BHP Billiton was quoted during the proposed WMC take over as having a value of \$89 billion. The cost of Australia’s work damage to people for one year is of the same order of magnitude.

**CONCLUSION**

The argument for focusing on Class I damaging occurrences (the 13 per cent) is very powerful as long as we know what they are. In mining you do not dig out all the material so that in the process you get the product (coal, iron ore, etc) you want. Rather, you map the formation, and in the case of coal, identify the seams and target them. Safety should work the same way.

The moment permanent alteration of life or permanent disability is mentioned the possibility (or in some people’s minds, the certainty) of malingering and fraud is raised. Nothing deactivates safety more. The prominence of, and our need to focus on Class I is robust.

The robustness is illustrated by testing the assumption that half of the Class I occurrences are not genuine. This gives 7.5 units of Class I damage and 85 units of Class II damage for a total of 92.5 units. Class I occurrences then make up eight per cent of occurrences. For costs with pain, suffering and early death included, the 96.5 halves to 48.25 units for Class I cost plus 3.5 units of cost for Class II, giving 51.75 units of total cost. Class I cost now is 93 per cent of total cost. Said simply, halving the number of Class I occurrences reduces Class I cost from 96.5 to 93 per cent of the total cost. Figure 4 graphically illustrates the above figures and shows that Class I occurrences will dominate the overall cost until very large Class I reductions have been made.

The development of a sufficiently detailed, comprehensive and organised information base to guide on site safety activities is necessary. This needs to include Class I injuries with detailed reporting of circumstances, damage and proposed preventative measures. The reporting of incidents which have potential to cause Class I injuries should be reported in the same detail. The data collection system also needs to look harder to capture data on the cases of Class I occupational disease and traumatic injuries that may have been contributed to by occupational exposures and disorders.

The state governments require that a vast number of Australians to identify hazards, do risk assessments and take effective control action – and get it right. If they do not they will be punished. This is equivalent to a teacher setting a class a subject, providing very limited resource material and examining with relatively obscure penetrating questions, with dire consequences for poor performance.

What do we need to do to develop a focusing database so that the upward Australian trend in permanent disability can be turned downwards?

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