Why are we not learning to manage manual tasks in the mining industry?

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A detailed review of WorkCover Western Australia data for the Mining Industry from 2003 to 2013 shows that manual tasks continue to produce high numbers of serious incidents resulting in serious injury for mining workers. Even with the concerted efforts towards “Zero Harm” during this time, this alarming trend continues. The review highlights the size of the permanent damage problem within Australian workplaces and the nature of the problem associated with Western Australian mining. The analysis of the data then provides hypotheses as to why this problem is not being effectively managed in mining workplaces. These hypotheses involve metrics influencing management focus, the egocentric approach, the quality of information provided and the cumulative effect of manual task damage. Further research should be conducted over time to test these hypotheses through the implementation of effective controls for manual tasks within the mining industry.

Practitioner Summary: Dr Ludcke has a Bachelor of Medical Engineering and a PhD, both from Queensland University of Technology (QUT). Dr Ludcke has been working as a consultant at InterSafe since 2001 and is now the General Manager. InterSafe is an engineering consulting firm specialising in Engineering Safer Workplace Solutions through effective incident investigation and scientific research. InterSafe consults to small-medium sized business as well as large national and multi-national companies.

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1. Introduction

While legislation requires organisations to prevent death, injury or illness to people within their workplace, it is hoped that moral and ethical drivers are also present for organisations to achieve this outcome. In the last 10 years, the notion of “harm” and more specifically “zero harm” has driven an organisation’s motivation to achieve this outcome. However, “zero harm” has created significant debate surrounding “What is harm?” and “Is zero achievable?” This paper is not intended to extend the debate regarding “zero harm”, but it is intended to provide insight into a type of “harm” that occurs from manual tasks that continues to plague the mining industry in Australia.

There is an old management adage suggesting that you cannot effectively manage what you do not understand. Typically, understanding requires some form of measurement or data collection and subsequent analysis. Effective management requires controls to be developed and implemented to address the problem that is deemed to be understood. This process then continues iteratively to collect and analyse further data and determine whether the controls have achieved the desired outcome.

This paper reviews the significant injuries associated with manual tasks within the Western Australian mining industry from July 2003 to June 2013, to understand whether effective management of this phenomenon has occurred and propose hypotheses as to why or why not.

2. Classification of Personal Damage

There are many and varied ways to classify the consequence of an incident / accident / damaging occurrence. No classification system is correct or right. The test of a classification system is its usefulness in assisting, understanding and directing efforts and resources.

Geoff McDonald in the 1960's proposed that consequence severity could be classified by the extent to which damage ultimately alters a person's future. Consequences are associated with damage to a person's tissue or function. Damage could be sudden, an injury, or could accumulate over time, a disease. McDonald proposed that it was useful to consider injury or disease as damage to a person's tissue or function. The classification system developed by McDonald and used by InterSafe, classifies damage into 3 classes:
• **Class I – Damage that permanently alters a person’s future.** Damaging occurrences in Class I include multiple fatalities (MF), single fatalities (SF) and Non-Fatal Permanent Damage (NFPD) such as amputations, impaired backs or shoulders, and psychological disturbance.

• **Class II – Damage that temporarily alters a person’s future.** The person is able to fully return to work, and life, after appropriate medical intervention with complete functional restoration. This type of damage includes broken bones, lacerations, or strained muscles.

• **Class III – Damage that is minor or insignificant and only inconveniences a person.** Persons are quickly able to return to work and life, often without medical intervention. This type of damage includes minor cuts, bruises or abrasions.

O’Neill et al (2013) suggests that this Class I, II and III classification of personal damage will become more universally accepted as the classification forms part of a recent report of Safe Work Australia.

### 3. Size of the Problem

There have been four snapshots of the damage to people from work in Australia, published by the Industry Commission (1995), the National Occupational Health and Safety Commission [NOHSC] (2004), the Australian Safety and Compensation Council [ASCC] (2009) and Safe Work Australia (2012). The four studies give baseline estimates for number of incidents and economic costs of these incidents for different levels of injury classification. Table 1 summarises the total cost of damage to people from work in Australia with relative costs, in terms of Class I and Class II, (Class III damage is not recorded nationally), for the four snapshots. These total costs are typically $5 – 6% of Gross Domestic Product (GDP).

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Class I Fatal</td>
<td>1.5%</td>
<td>3.5%</td>
<td>3.3%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Class I Non-fatal</td>
<td>80.5%</td>
<td>88.5%</td>
<td>88.0%</td>
<td>85.2%</td>
</tr>
<tr>
<td>Class II</td>
<td>18.0%</td>
<td>8.0%</td>
<td>8.7%</td>
<td>9.5%</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$20 Billion</strong></td>
<td><strong>$34.3 Billion</strong></td>
<td><strong>$57.5 Billion</strong></td>
<td><strong>$60.6 Billion</strong></td>
</tr>
</tbody>
</table>

Table 1 demonstrates that the majority of cost is associated with Class I damage, particularly Class I Non-Fatal Permanent Damage (NFPD). Table 1 also shows that the estimated cost of damage to people from work in Australia has increased by 203% in 16 years. While inflation will account for some of this increase, an increase in the number of incidents (particularly NFPD) will also have had some influence.

Table 2 summarises the numbers of people experiencing Class I damage (Fatal and NFPD) for the years listed along with a calculation of frequency and likelihood for NFPD.

<table>
<thead>
<tr>
<th>Year</th>
<th>Traumatic Fatality Incidents</th>
<th>NFPD Incidents</th>
<th>NFPD Frequency</th>
<th>Size of Australian Workforce</th>
<th>Traumatic Fatality Likelihood</th>
<th>NFPD Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992-93</td>
<td>693</td>
<td>50,018</td>
<td>137/day</td>
<td>6,560,000</td>
<td>1 in 9,466</td>
<td>1 in 131</td>
</tr>
<tr>
<td>2000-01</td>
<td>410</td>
<td>48,900</td>
<td>134/day</td>
<td>9,009,000</td>
<td>1 in 21,973</td>
<td>1 in 184</td>
</tr>
<tr>
<td>2005-06</td>
<td>393</td>
<td>64,000</td>
<td>175/day</td>
<td>11,200,000</td>
<td>1 in 28,499</td>
<td>1 in 175</td>
</tr>
<tr>
<td>2008-09</td>
<td>400</td>
<td>85,800</td>
<td>235/day</td>
<td>11,930,000</td>
<td>1 in 29,825</td>
<td>1 in 139</td>
</tr>
</tbody>
</table>

*ABS Catalogue 6202.0 Labour Force Australia May 2011.*

Tables 1 and 2 clearly indicate that the “size of the problem” is worth turning our moral and ethical heads towards solving. Tables 1 and 2 also shows that some initial understanding of the “nature of the problem” can be provided by classifying according to ‘Class I – Permanent’, ‘Class II – Temporary’ and ‘Class III – Minor’ to highlight the significance of NFPD.

Table 2 shows that the likelihood of Class I – Traumatic Fatality has been decreasing over the 16 year period. This is a positive situation for the Australian workplace but still presents “sovereign risk” for the deceased and their families, people in the management structure and in some cases, small businesses. However, Table 2 also shows that the likelihood of Class I – NFPD has not altered significantly over the same 16 year period.
4. Mining Industry Context

WorkCover Western Australia provided access to mining industry insurance claims data from July 2003 to June 2013 in order to assist the mining industry in understanding the continuing patterns and subsequently, manage the problem. The severity of incidents in the dataset is predominantly measured by the number of days of lost time. InterSafe’s previous experience in analysing many NFPD and lost time injury (LTI) datasets has shown that filtering LTI incidents by >60 days provides a dataset with a sufficient number of incidents to work with, while maintaining consistent patterns or trends with NFPD. The exceptions to this relate to incidents like noise related hearing loss that appear as NFPD but do not regularly result in time off work. The >60 day LTI trend for Western Australian mining is provided in Table 3.

Table 3. Western Australian Mining Industry Trend of >60 day LTI incidents over time

<table>
<thead>
<tr>
<th>Year</th>
<th>&gt;60 day LTI Incidents</th>
<th>&gt;60 day LTI Frequency</th>
<th>Size of WA Mining Workforce</th>
<th>&gt;60 day LTI Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003-04</td>
<td>162</td>
<td>0.44/day</td>
<td>39,336</td>
<td>1 in 243</td>
</tr>
<tr>
<td>2004-05</td>
<td>196</td>
<td>0.54/day</td>
<td>43,245</td>
<td>1 in 221</td>
</tr>
<tr>
<td>2005-06</td>
<td>200</td>
<td>0.55/day</td>
<td>50,810</td>
<td>1 in 254</td>
</tr>
<tr>
<td>2006-07</td>
<td>263</td>
<td>0.72/day</td>
<td>51,501</td>
<td>1 in 196</td>
</tr>
<tr>
<td>2007-08</td>
<td>284</td>
<td>0.78/day</td>
<td>61,164</td>
<td>1 in 215</td>
</tr>
<tr>
<td>2008-09</td>
<td>342</td>
<td>0.94/day</td>
<td>60,607</td>
<td>1 in 177</td>
</tr>
<tr>
<td>2009-10</td>
<td>436</td>
<td>1.19/day</td>
<td>71,743</td>
<td>1 in 165</td>
</tr>
<tr>
<td>2010-11</td>
<td>454</td>
<td>1.24/day</td>
<td>88,698</td>
<td>1 in 195</td>
</tr>
<tr>
<td>2011-12</td>
<td>508</td>
<td>1.39/day</td>
<td>107,578</td>
<td>1 in 212</td>
</tr>
<tr>
<td>2012-13</td>
<td>411</td>
<td>1.13/day</td>
<td>114,600</td>
<td>1 in 279</td>
</tr>
</tbody>
</table>

Table 3 shows an alarming increase in the number of >60 day LTI incidents from 2003-04 (162) through to 2011-12 (508), with a slight reduction in 2012-13 (411). This 3 fold increase in the number of incidents coincides with a similar 3 fold increase in the size of the mining workforce.

Table 3 also shows that the likelihood trend for >60 day LTI incidents in the Western Australian mining generally worsened from 2003-04 through to 2009-10 but has shown signs of improvement from 2010-11 through to 2012-13, to levels that are similar to that which occurred almost 10 years ago.

Hence, during the 10 year period from 2003-04 to 2012-13, the Western Australian mining industry is seriously injuring more than double the number of people with a similar likelihood of injury. Meanwhile, during this period, significant changes have been made in the health and safety focus of the industry associated with “zero harm” and other positive initiatives. Therefore, based on this data collection and measurement, the following hypotheses can be developed:

1) The problem being managed is not appropriately understood; or
2) The controls being implemented are not effective.

5. Understanding the Nature of the Problem

To further understand the “nature of the problem” for the >60 day LTI incidents within the mining industry, the individual incidents within the WorkCover Western Australia data were reviewed to determine patterns and develop a taxonomy.

Taxonomy is one of the oldest and most time honoured methods used in science. It is a classification system with an internal structure. It has its origins in Biology with its branching tree classification of the living world into Kingdom (Animalia), Class (Vertebrata), Order (Primates) Genus (Homo) Species (sapiens). It has the great advantage of presenting an overall and somewhat detailed picture in a very limited space.

To assist in understanding the “nature of the problem”, another classification system is required to assist in the development of the taxonomy. For over 50 years, researchers like Gibson (1961), Haddon (1963, 1964, 1968, 1970, 1983) and more recently summarised by Guarnieri (1992), have described personal damage as a consequence of an energy exchange. When the exchange of energy goes outside tolerable limits of the body, it damages tissue or function and hence the concept of a Damaging Energy Exchange.
Geoff McDonald and InterSafe have developed a damaging energy classification system referred to as Energy Concepts™ that is regularly used by InterSafe in the development of taxonomies.

The WorkCover Western Australia data has been analysed by InterSafe using Energy Concepts™ to classify the data on three separate occasions over the past 7 years. The three datasets were:

- 2003-04 to 2006-07 (4 years) = 801 incidents;
- 2007-08 to 2008-09 (2 years) = 612 incidents;
- 2009-10 to 2012-13 (4 years) = 1907 incidents.

Figure 1 shows the highest level breakdown into the energies that produced the damage for each of the 3 datasets. It is clear to see that “Human Energy” remains the dominant energy across all datasets, with 47% of all incidents. “Human Energy” incidents result in damage arising from expenditure of Energy within the human body.

Figure 2 shows the second level breakdown for “Human Energy” into mechanism for each of the 3 datasets. The results in Figure 2 show that “Manual Tasks” (55% of all “Human Energy” incidents) remains the dominant mechanism in producing damage across all datasets. Incidents that occurred “During Body Movement” (i.e. without handling an object) were the next most significant taxon for “Human Energy” with only 15% of the incidents. Interestingly, “Repetitive Tasks” only produce 10% of the “Human Energy” >60 day LTI incidents within Western Australian mining.
Figure 2. Western Australian Mining >60 day LTI breakdown by mechanism for “Human Energy” for (a) 2003 – 2007, (b) 2007 – 2009, and (c) 2009 - 2013.

Figure 3 shows the third level breakdown for “Manual Tasks” into task type for each of the 3 datasets. The breakdown in Figure 3 indicates that “Lifting” or “Lifting/Lowering” tasks (48% of all “Manual Tasks”) remains the dominant task that produces >60 day LTI incidents across all datasets. “Pushing/Pulling” tasks (20% of all “Manual Tasks”) are the second most prevalent task type. Further breakdowns into the types of objects being handled at the time of the incident are also available to provide further understanding, but are not provided in this paper.

Figure 3. Western Australian Mining >60 day LTI breakdown for “Manual Tasks” by task type for (a) 2003 – 2007, (b) 2007 – 2009, and (c) 2009 - 2013.
6. Analysis

The results of the taxonomies show that the type of tasks that are producing significant levels of personal damage within the Western Australian mining industry for 10 years are relatively simple lifting, lowering, pushing and pulling tasks. These types of tasks are not new to the industry and have not suddenly been created by changes in equipment or technology. Hence, the question arises as to “Why do manual tasks continue to be the dominant feature in producing serious and permanent injury to mining workers?”

Based on InterSafe’s significant exposure in working with the mining industry, various hypotheses regarding the mining industry’s ability to effectively manage the problem have been developed. These hypotheses can be grouped into two main areas:

1) Generic or indirect issues; and
2) Specific or direct task based issues.

6.1 Generic or Indirect Issues

Some of the generic or indirect issues within companies that are believed to be influencing the proliferation of manual task incidents are:

• The influence of specific metrics like All Injury Frequency Rate (AIFR), Lost Time Injury Frequency Rate (LTIFR) and Total Recordable Injury Frequency Rate (TRIFR) on management focus.
  ➔ It is well known within industry that minor damage (e.g. Class III) will occur more frequently and subsequently have a higher number of incidents than temporary damage (e.g. Class II). Similarly, temporary damage (e.g. Class II) will occur more frequently and subsequently have a higher number of incidents than permanent damage (e.g. Class I). AIFR, LTIFR and TRIFR all incorporate Class II temporary damage as the minimum threshold incident severity that is captured by the measure. In addition, there is little or no weighting applied for the severity of the incident (e.g. permanent vs temporary damage) once this threshold is met. Therefore, the incidents that will have the greatest influence on the Frequency Rate measure are those with the lowest severity as they will occur more frequently. For example, there is a high likelihood that cuts from knives will take precedent in the management focus over heavy lifting manual tasks.

• The focus on “Zero Harm” will also influence management focus.
  ➔ The general concept of “Zero Harm” provides the notion that all harm, no matter how severe or significant, needs to be prevented. While this is morally and ethically correct, it can also spread the management focus beyond the capability of their resources. Hence, just like in the Frequency Rate situation, priority is placed on the lower severity incidents that happen more frequently.

• The egocentric nature of the mining industry.
  ➔ The mining industry has a reputation of being a hard and tough industry to work in. Working conditions in a mine are typically not equivalent to an air-conditioned office. In addition to the hardness and toughness of the people working in the industry, comes an egocentric nature in relation to incidents. An egocentric approach places the person at the centre of incident causation and typically assigns blame or fault to that person. Hence, there is a belief that correcting their behaviour (or in an extreme case dismissing them) will remove the problem. However, the data clearly shows that the problem persists. Therefore, an ergonomic approach looking at the interaction of people, equipment and the environment to create more effective controls, may be required.

6.2 Specific or Direct Issues

Some of the specific or direct issues that are believed to be influencing the proliferation of significant personal damage from manual tasks are:

• The absence of relevant information being provided to mining workers to assist them in managing the problem.
  ➔ The quality of relevant information provided to mining workers is generally poor. Relevant information will assist them in understanding the risk factors associated with manual tasks and the effectiveness of controls. The most commonly recognised piece of information recalled by mining workers from their manual handling training is to ensure they lift with their
“knees bent, back straight”. However, ergonomist’s and human factors expert’s recognise that the weight of the lift as well as the vertical and horizontal location of the hands relative to the body, are arguably more critical issues to address during a lifting task. Unfortunately, this is not the information that is propagated throughout the mining industry to assist in managing manual tasks.

- The cumulative effect of manual tasks over time.
  - There is a significant amount of research published regarding the cumulative build-up of soft tissue damage leading to pain onset. The pain onset is often unrelated to the tasks that produced the damage to soft tissue, but may occur during or soon after an overexertion task. The damage is associated with heavy lifting, lowering, pushing and pulling tasks. For the injured person there may be little or no difference between the lifting task conducted at the onset of pain and multiple other lifting tasks conducted prior to the onset of pain, where no pain was experienced. Hence, the numerous previous lifts that were conducted with no pain onset will have reinforced to the worker and the management that these previous overexertion tasks were acceptable tasks. This is a very different phenomenon to a fall from height or a motor vehicle incident.

- The egocentric response to manual task incidents.
  - Different types of incidents will tend to have different reactions from workers and management in relation to the egocentric response. A near miss incident where someone was almost struck by a forklift will be readily reported by either the pedestrian or the forklift operator depending on who believed they were least at fault. However, the person who experiences pain as a consequence of a manual task can often be considered to be the person at fault in an egocentric assessment as they were the person who made the decision to lift the object. Therefore, the egocentric response from management will typically detract from any reporting of incidents with only minor damage or a bearable amount of pain, where intervention would be most effective. Hence, workers will continue to undertake manual tasks with minor pain and produce further, more significant damage that can no longer be concealed and there will certainly be no reporting of heavy to very heavy manual tasks that were completed pain free and yet had the potential to damage soft tissue.

7. Conclusions

The results of the review of data for the Western Australian mining industry for 2003 to 2013 clearly show that manual tasks continue to provide significant levels of personal damage for mining workers. The types of tasks that are most prevalent in producing this damage are lifting, lowering, pushing and pulling tasks. Based on InterSafe’s significant exposure in working in the mining industry, various hypotheses regarding the mining industry’s ability to effectively manage the problem have been developed. These hypotheses include:

- The influence of metrics like AIFR, LTIFR and TRIFR as well as “Zero Harm” on management focus;
- The egocentric response to people experiencing pain attributed to a work task and specifically the manual task incident type;
- The quality of relevant information provided to mine workers to assist in understanding/managing the problem; and
- The cumulative effect of manual task damage over time versus a single traumatic event.

Further research should be conducted over time to test these hypotheses through the implementation of different approaches, with respect to manual tasks management within the mining industry. Some of these potential approaches include:

- Removing or altering metrics to ensure that Class I permanent damage has sufficient focus;
- Providing relevant factual information for workers to understand and manage the problem;
- Introducing the ergonomic approach to incident management;
- Striving for engineering controls rather than just administrative controls;
- Promoting ergonomic conversations with respect to manual tasks that are overstressing and overstraining the musculoskeletal structure.

Based on InterSafe’s experience, modifying management focus to include some or all of these approaches will start to address the manual tasks issue within the mining industry.
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References


