OCCUPATIONAL HEALTH AND SAFETY PRIORITIES FOR THE QUEENSLAND COAL INDUSTRY

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SUMMARY

The University of Ballarat, funded by the Australian Coal Association Research Program (ACARP), has analysed workers' compensation claims relating to the black coal mining industry in Queensland (ACARP Project No. C8025). Approximately 2287 claims relating to injuries that occurred between 1/7/97 to 25/3/99 were analysed. Variables included: occupation, mine type (underground v open cut), nature of injury, body location, compensation cost, and days lost.

INTRODUCTION

Over recent years the mining industry in Australia has improved its OHS performance significantly (1). Likewise, the coal industry in Queensland has achieved a reduction in lost time injuries. Between 93/94 and 97/98, the lost-time injury frequency rate (LTIFR) in open cut mining has dropped from 24.9 to 7.8 and the rates in underground mining have dropped from 73 to 39.4 (2).

It is worthwhile at this time to examine compensation data to determine priorities that are likely to result in a continuing fall in claims and compensation costs. Therefore the aim of the research discussed in this paper is to *identify priority OHS issues to be addressed that will achieve greatest return on strategic investment for the Queensland coal industry*.

Very often, a lost-time injury frequency rate (LTIFR) is used as an indicator of the level of injuries. Because of the focus on determining priorities that will achieve financial returns, the analysis here mainly uses claims cost rather than the number of claims. Further, the analysis here is based on all claims rather than only lost-time claims.

The research reported here is part of a broader analysis that includes both Queensland and NSW data. The project is currently underway and it is intended that Queensland and NSW data be analysed as a combined set of data. At the time of writing, this analysis has not been undertaken. This paper is therefore a preliminary analysis of the Queensland data. The research is funded by the Australia Coal Association Research Program (ACARP).

METHODS

Workers' compensation injury and disease claims data for the black coal mining sector for the period 1 July 1997 to 25 March 1999 were obtained from WorkCover, Queensland. This period was chosen because prior to 1 July 1997, the coding of the data did not enable black coal mining to be differentiated from other types of mining.

The data set included 2287 claims.

The fields included:

(a) Mine Type (Underground v Open cut)
(b) Injury Date
(c) Occupation (text)
(d) Nature of Injury (text)
(e) Part of Body (text)
(f) Action at time of Injury (text)
(g) Workplace (text)
(h) Work Days Lost
(i) Total Statutory Payments
- Compensation Payments
- Hospital Payments
- Lumpsum Payments
- Medical Payments
- Other Payments
- Rehabilitation Payments

All fields were reasonably complete with the exception of occupation. The occupation field was generally incomplete for dates prior to 1 January 1998 and generally complete since.

The text fields of "occupation", "nature of injury" and "part of body" were converted from text to codes. The codes used were as per the NSW Joint Coal Board system (given the intention described earlier to analyse the Queensland and NSW data in a combined set). Among the data there are some occupations, types of injury and parts of body that appear only a small number of times. So as to reduce the complexity of the analysis and reporting, specific occupations, injuries and parts of body, were included where they contributed at least $10,000 in total cost and otherwise they were grouped. As can be seen in Table 6, Table 7 and Table 8 (APPENDIX A), this grouping of variables with low cost resulted in 13 occupations, 15 injury types, and 21 body locations.

Because the claims are relatively recent, some of the files remain open. The ongoing nature of some claims should not affect comparisons by mine type, occupation, etc as one would expect that the ratio of open/closed claims would be about equally dispersed across these variables.

RESULTS

Summary Information

Table 1 shows the mean claim cost by mine type and the breakdown of components of this cost. The mean claim cost was $2031 and the mean number of days lost was 4.3. Compensation payments dominated the breakdown, consisting of 54% of the total cost. Lump sum payments and medical costs were also prominent at 20% and 13% respectively.

All cost components correlated highly with the total claim cost (Pearson correlation coefficient = 0.559 to 0.853) and were all significant at the 0.01 level. Therefore for further analysis of the data, the total claim cost was used as the dependent variable.

Table 1 Claims cost: by component

	Mean	Median	Maximum	Total
(Days Lost)	(4.3)	(0)	(411)	(9890)
Compensation	$1,105	$0	$107,530	$2,527,413
Hospital	$98	$0	$9,450	$223,359
Lump Sum	$413	$0	$144,886	$944,032
Medical	$263	$64	$9,095	$601,443
Other	$113	$0	$10,390	$259,558
Rehabilitation	$39	$0	$13,830	$88,498
Total	$2,031	$103	$162,805	$4,644,304

Table 2 shows the claims cost data by the number of days lost. Most of the claims (1970 claims or 86%) involved no days lost (and 464 of these claims involved no payment of any type) leaving 317[1] lost-time claims (14%) costing $3.6M (or 77% of the claims cost). The no-lost-time claims constituted a total cost of about $1M or 23%. In contrast, claims involving greater than five days lost represented only 10% of claims but contributed to 74% of the total cost.

Table 2 Claims cost: by days lost

Days Lost	0	1-5	>5	All lost time
N	1970	105	212	317
% N	86%	4.6%	9.3%	14%
Mean	$534	$1,317	$16,295	$11,334
Median	$76	$1,023	$7,907	$4,551
Maximum	$151,285	$9,652	$162,805	$162,805
Total	$1,051,559	$138,268	$3,454,477	$3,592,745
% Total	23%	3.0%	74%	77%

Table 3 shows the claims cost by mine type. Table 4 and Table 5 show the data standardised by the number of employees working in each type of mine.

[1] These data are somewhat inconsistent with the Department of Mines and Energy (1) data. For 97-98, DME report 369 lost time injuries. Of the 317 lost time claims in the data set analysed here only 227 had an injury date in 97-98.

It appears as though the average claim for open cut mining ($2,479) was greater than for underground mining ($1,645). When the data is standardised for the number of employees we can easily see that there was an obvious difference in the claims incidence rate (including no lost time claims) determined by the type of mine. The claims incidence was about 3.6 times greater for underground mines than for open cut mines (underground mine=0.304 claims per employee per annum; open cut mine=0.084). In comparison the lost-time injury frequency rate (not calculated here) reported by the DME (2) for underground mines in 1997-98 was about five times greater than that for open cut mines (Underground = 39.4 lost-time claims per million hours; Open Cut=7.8).

Because of the greater average severity of the open-cut claims, the difference between mine types is not so great when comparing mine types by the cost per employee. These figures show that the cost of injuries in underground mines is about 2.5 times that in open cut mines. Injuries in open cut mines cost an average of $209 per employee per annum whereas the figure for underground mines was $500 per employee per annum.

Table 3 Claims cost: by mine type

	N	Mean	Median	Max	Total
UG	1229	$1,645	$94	$83,441	$2,021,641
UG	1229	$1,645	$94	$83,441	$2,021,641
OC	1058	$2,479	$120	$162,805	$2,622,663
OC	1058	$2,479	$120	$162,805	$2,622,663
Total	2287	$2,031	$103	$162,805	$4,644,304
Total	2287	$2,031	$103	$162,805	$4,644,304

Table 4 Claims per employee per annum: by mine type

	N E'ees[a]	N Claims	N Claims pa[b]	Claims/ E'ee pa
UG	2,332	1,229	709	0.304
OC	7,237	1,058	610	0.084
Total	9,569	2,287	1319	0.138

[a] JCB & DME Queensland (3). Based on weighted average of 33% 1997 employment figures and 66% 1998 employment figures (1999 not available).
[b] Based on study period of 633 days

Table 5 Claims cost per employee per annum: by mine type

	N E'ees[a]	Total Cost	Cost pa[b]	Cost/ E'ee pa
UG	2,332	$2,021,641	$1,165,717	$500
OC	7,237	$2,622,663	$1,512,278	$209
Total	9,569	$4,644,304	$2,677,995	$280

[a] JCB & DME Queensland (3). Based on weighted average of 33% 1997 employment figures and 66% 1998 employment figures (1999 not available).
[b] Based on study period of 633 days

Occupation, Nature of Injury and Part of Body

There appears to be no outstanding occupation in terms of severity of claim shown in Table 6 (APPENDIX A). Typically the production workers (especially open cut miners, drivers and plant operators) and supervisors suffer the most serious injuries. Fitters and boilermakers also seem to suffer serious injuries while other trades including mechanical fitters and electricians suffer less serious injuries more in line with those experienced by engineering and administrative staff.

As shown by Table 7 and Table 8 (APPENDIX A) the most costly injuries appear to be amputations and multiple injuries while the most costly claims seem to be associated with multiple parts of the body. Comparison with the Department of Mines and Energy report (2) shows differences in the ordering of the nature of injury and part of body injured. The reason for these differences are that the DME data is ordered according to the number of injuries rather than the cost.

Analysis of Specific Injuries

To determine priorities to a better defined level, Table 9 lists the top twenty part of body/nature of injury combinations (by cost). These top twenty injuries to specific parts of the body totalled $3.9M or 84% of the total cost.

From this analysis it can be seen that four types of injuries contribute 81% of the total cost. These four injury types are:

- *Sprains and strains of the back (cost: $1M)*

  Four-hundred and fourteen (414) sprains and strains of the back (mainly low back) cost $0.94M (20% of total claims cost) at an average cost of $2,280 per claim. These injuries resulted in 2537 days lost time (25.6% of total).

- *Sprains and strains of the knee, neck, ankle and shoulder (cost: $1M)*

  Four-hundred and sixty-seven sprains and strains of the knee, neck, ankle and shoulder cost 1.0M (22% of the total cost) at an average cost of $2,175 per claim and resulted in 2680 days lost (or 27.1% of the total).

- *Serious traumatic injuries (cost $1M)*

  Forty-seven serious traumatic injuries (2% of the 2287 claims) such as fractures, crushing, amputation, abrasion and multiple injuries cost of $1.0M or 22% of the total cost (average cost of $21,698 per claim) and a similar proportion of the total days lost (1925 days lost or 19.5% of the total).

- *Deafness (cost: $0.5M)*

  Three-hundred and seventeen (317) deafness claims cost $0.54M (12% of total cost) at an average cost of $1,711 per claim. Deafness claims represent a departure from the typically strong relationship between days lost and total compensation. The 317 deafness claims only resulted in a total of 3 days lost.

DISCUSSION

Priorities

Soft-tissue injuries (sprains and strains) are clearly the dominant feature constituting about half the total cost. Looking at specific injury types (Table 9) we see that strains of the lower back (15.4%) and other parts of the back (4.9%) are important and probably come as no surprise. They reinforce what we have known for some time and support programs for addressing this type of injury.

The other body locations that feature strongly in the strain type of injury may be less well known. Strains of the knee (8.3%), neck (6.1%), ankle (4.0%), and shoulder (3.5%) total about 22% of the cost. Specific investigation of the circumstances of these types of injury and subsequently determination of a preventative approach would be worthwhile.

Deafness remains a common problem. Deafness claims constituted 12% of the claims cost and is the second most common specific injury (see Table 9). The causative aspects of deafness are well known as are the methods of assessment of noise levels. Similarly, the means of controlling noise follow a fairly standardised methodology (control at source, noise pathways, etc). For this reason it would be worthwhile continuing to place some effort in the area of noise control and the minimisation of deafness. The clear priority is to continue efforts to achieve safe noise levels at the equipment design and manufacture stage through concerted industry-level action including purchasing controls. This is not to say that worksite-level action is not warranted but that the main opportunity for long term eradication of noise can be grasped by manufacturers rather than users.

Serious traumatic injuries are the fourth priority and are discussed in more depth as follows.

Causation of Serious Traumatic Injuries

Serious traumatic injuries constituted only 2% of the claims and yet made up 22% of the cost.

Possibly these serious injuries share a similar pattern of causation with many minor injuries but nevertheless it may be worth examining some further information about these serious and costly injuries to attempt to gain some clues about a prevention strategy.

The "action at time of injury" text field contains some limited information. Table 10 shows the text recorded relating to the 47 serious traumatic injuries that figure in the "top 20" *part of body/nature of injury* data shown in Table 9.

The descriptions are very brief. From this limited information it seems that vehicle accidents are prominent in the causation of multiple injuries and that various items of plant feature in the list and are likely to be important aspects of many other events.

Preventative Programs

In general, the lack of information about the activity at the time of the injury causes some difficulties in developing firm ideas about specific ways to target injury prevention. Some ideas for enhancing knowledge about common injury types and finding ways to prevent these injuries are discussed as follows.

1. Further data fields, such as the involvement of plant could be useful if an alternative data collection system was proposed. The NSW JCB data system includes provision for the collection of more extensive data including information about the involvement of plant, etc. Whether the JCB data will therefore be more illuminating is yet to be discovered as the data has not been explored at this time.

2. The Department of Mines and Energy database is an existing source of some additional information about injuries. However there has been historically no link between a WorkCover claim and a DME investigation. As of 1 July 1999 reports of accidents to DME will apparently include provision for the listing of a WorkCover claim number and hence in the future it may be possible to make such links to use the information from both bodies in a complementary fashion. In a previous project there has been an attempt to merge the data sets (4) with mixed results due to data inconsistency.

3. A model of in-depth investigation could be developed, or an existing model utilised, to undertake selected investigations into clusters of injury types in order to develop ideas for prevention. This could be in the form of discrete research activities into injury clusters with the aim of developing preventative plans.

4. An industry-cooperative approach could be developed to formally share internal accident investigation information in the form of a database. Industry-standard models of investigation could be agreed to provide consistency of approach and to guide investigators toward describing the hazard source and identifying the failures in hazard control.

CONCLUSIONS

Claims costs are clustered in a small number of injury type/body location combinations:

1. strains of the back;
2. strains of other joints, specifically the knee, neck, shoulder and ankle;
3. serious traumatic injuries such as fractures, crushing, amputation, abrasion and multiple injuries; and
4. deafness.

In terms of controlling cost, these injury types should be targets for preventative activity.

The extent of knowledge about preventing these injuries varies according to the injury type. The problem of deafness and the problem of serious traumatic injuries illustrate this point. In the case of deafness we know that noise is the cause. From this point the assessment of noise associated with various types of plant can be conducted and noise controlled utilising well-defined methodologies. Like the case with deafness, we can predict the involvement of plant in serious traumatic injuries, however unlike noise, the identification of items or classes of plant that present the greatest risk and the determination of control strategies is somewhat more complicated.

While there are differences in our knowledge about these injuries and likely differences in prevention approaches, there will be benefit to be gained from employing some common principles. One of these principles will be the approach of seeking improvement of the safety at the equipment design stage.

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APPENDIX A

Table 6 Claims costs: by occupation

Occupation	N	Mean	Median	Maximum	Total	%	Cum %
Miner (underground)	618	$2,337	$99	$83,441	$1,444,030	31%	31%
Miner (open cut)	226	$4,165	$192	$162,805	$941,179	20%	51%
Drivers, other plant operators, etc.	239	$3,129	$156	$121,840	$747,955	16%	67%
Foreman/Supervisor	59	$4,490	$276	$151,285	$264,891	6%	73%
Fitter, Welder	178	$1,365	$100	$43,115	$242,897	5%	78%
Boilermaker, Welder	77	$2,365	$85	$86,697	$182,094	4%	82%
Deputy	95	$1,776	$145	$31,802	$168,743	4%	86%
Labourers, other workers	67	$2,306	$110	$39,163	$154,532	3%	89%
Engineers, Scientists, Administration, etc.	98	$580	$88	$11,465	$56,804	1%	91%
Eng Fitter, Mech Fitter, Plant Mechanic (incl. apprentice).	73	$736	$95	$8,673	$53,762	1%	92%
Other trades	42	$863	$71	$9,428	$36,225	1%	92%
Electrician (incl. apprentice)	49	$587	$81	$8,117	$28,766	1%	93%
Miner technician (underground)	29	$949	$147	$10,361	$27,524	1%	94%
Missing	437	$675	$80	$46,971	$294,901	6%	100%
Total	2287	$2,031	$103	$162,805	$4,644,304		

Table 7 Claims cost: by nature of injury

Nature of Injury	N	Mean	Median	Maximum	Total	%	Cum %
Strain	1053	$2,067	$137	$121,840	$2,177,044	47%	47%
Fracture	119	$4,675	$205	$70,546	$556,295	12%	59%
Deafness	317	$1,711	$152	$15,885	$542,297	12%	71%
Multiple injuries	11	$30,225	$1,878	$151,285	$332,471	7%	78%
Amputation	7	$31,739	$15,106	$162,805	$222,175	5%	82%
Laceration, cut	215	$830	$81	$27,191	$178,347	4%	86%
Bruise, contusion	173	$844	$67	$38,854	$145,980	3%	89%
All other injuries, diseases	77	$1,415	$74	$36,609	$108,927	2%	92%
Crushing	54	$1,875	$96	$45,598	$101,260	2%	94%
Hernia	16	$5,443	$5,645	$13,881	$87,082	2%	96%
Abrasion	24	$3,298	$31	$66,440	$79,159	2%	98%
Malignant neoplasms & carcinomas	4	$8,681	$378	$33,969	$34,725	1%	98%
Contact dermatitis	48	$577	$45	$19,396	$27,687	1%	99%
Foreign body	120	$146	$53	$2,157	$17,530	0%	99%
Burn	31	$425	$54	$5,274	$13,173	0%	100%
Missing	18	$1,119	$236	$6,790	$20,150	0%	100%
Total	2287	$2,031	$103	$162,805	$4,644,304		

Table 8 Claims cost: by part of body injured

Part of Body	Valid N	Mean	Median	Maximum	Sum	%	Cum %
Lower back	304	$2,509	$160	$121,840	$762,767	16%	16%
Ear	334	$1,728	$135	$33,969	$577,069	12%	29%
Knee	175	$2,626	$125	$61,140	$459,515	10%	39%
Hip, upper leg, lower leg	75	$5,773	$81	$162,805	$432,993	9%	48%
Multiple	23	$14,546	$127	$151,285	$334,548	7%	55%
Upper back, lower back and back unspecified	123	$2,489	$80	$70,546	$306,175	7%	62%
Neck	132	$2,152	$212	$78,092	$284,102	6%	68%
Fingers, thumbs, hands	326	$826	$81	$27,191	$269,409	6%	74%
Foot, toes	101	$2,594	$114	$48,959	$262,015	6%	79%
Ankle	100	$2,510	$130	$83,441	$251,030	5%	85%
Shoulder	124	$1,545	$154	$43,115	$191,533	4%	89%
Abdomen, chest, ribs, etc.	78	$2,148	$136	$15,329	$167,542	4%	93%
Head and face except eye and ear	81	$1,483	$79	$66,440	$120,102	3%	95%
Arms	67	$1,180	$71	$19,396	$79,055	2%	97%
Wrist	40	$911	$113	$19,552	$36,434	1%	98%
Nervous system	6	$5,392	$237	$19,083	$32,355	1%	98%
Disease	4	$7,395	$117	$29,347	$29,581	1%	99%
Elbow	49	$600	$63	$11,767	$29,403	1%	100%
Eye	131	$122	$42	$3,726	$15,993	0%	100%
Respiratory system	9	$282	$95	$849	$2,541	0%	100%
Systemic unspecified and unspecified part of body	5	$28	$0	$78	$141		
Missing	0						
Total	2287	$2,031	$103	$162,805	$4,644,304		

Table 9 Part of body/Nature of injury Combinations (top 20 by cost)

Part of Body	Nature of Injury	N	Days Lost		Cost					
			Total	%	Mean	Median	Max	Total	%	Cum%
Lower Back	Strain	299	2023	20.5%	$2,388	$161	$121,840	$713,986	15.4%	15%
Ear	Deafness	317	3	0.0%	$1,711	$152	$15,885	$542,297	11.7%	27%
Knee	Strain	148	1058	10.7%	$2,590	$153	$61,140	$383,253	8.3%	35%
Multiple	Multiple injuries	11	351	3.5%	$30,225	$1,878	$151,285	$332,471	7.2%	42%
Neck	Strain	127	628	6.3%	$2,228	$216	$78,092	$282,918	6.1%	49%
Upper back, lower back and back unspecified	Strain	115	514	5.2%	$1,998	$80	$53,787	$229,799	4.9%	54%
Ankle	Strain	82	625	6.3%	$2,274	$122	$83,441	$186,471	4.0%	58%
Hip, upper leg, lower leg	Amputation	2	166	1.7%	$89,723	$89,723	$162,805	$179,446	3.9%	61%
Shoulder	Strain	110	369	3.7%	$1,484	$143	$43,115	$163,208	3.5%	65%
Hip, upper leg, lower leg	Fracture	4	496	5.0%	$36,197	$37,117	$47,948	$144,787	3.1%	68%
Foot, toes	Fracture	9	279	2.8%	$12,643	$2,989	$48,959	$113,787	2.5%	70%
Fingers, thumb, hand	Laceration, cut	133	182	1.8%	$850	$81	$27,191	$113,001	2.4%	73%
Hip, upper leg, lower leg	Strain	19	318	3.2%	$4,602	$51	$37,114	$87,446	1.9%	75%
Abdomen, ribs, chest, etc	Hernia	16	236	2.4%	$5,443	$5,645	$13,881	$87,082	1.9%	77%
Upper back, lower back and back unspecified	Fracture	1	72	0.7%	$70,546	$70,546	$70,546	$70,546	1.5%	78%
Head & face (not eye nor ear)	Abrasion	1	244	2.5%	$66,440	$66,440	$66,440	$66,440	1.4%	80%
Foot, toes	Crushing	12	163	1.6%	$4,993	$92	$45,598	$59,915	1.3%	81%
Ankle	Fracture	7	154	1.6%	$7,490	$5,230	$25,514	$52,433	1.1%	82%
Lower back	Bruise, contusion	5	137	1.4%	$9,756	$68	$38,854	$48,781	1.1%	83%
Foot, toes	Strain	29	127	1.3%	$1,596	$301	$31,802	$46,289	1.0%	84%
Total		1447	8145	82.4%				$3,904,355	84%	

Table 10 Causation of Serious Traumatic Injuries

Part of Body	Nature of Injury	Acton at Time of Injury (text field)
Head/face	Abrasion	"Preparing a crane – carrying out the pre-startup check"
Ankle	Fracture	"Twisted ankle when stepping back to avoid falling block." "Stepped back off equipment." "Just completed installing roof bolts." "Loading pod." "Checking water damage on embankment." "Running to turn delivery hose off." Advancing shields on longwall."
Back	Fracture	"Drove vehicle over 14 metre drop"
Foot, toes	Crush	"Carrying block of timber." "Swinging sledge hammer." "Lifting steel ram of tailgate drive." "Fitting shearer down drive support plate." "Tramming drill rig backwards." "Drilling hole into rib with rib bolter." "Walking to read of continuous miner." "Lowering support of longwall chock." "Standing waiting for AFC to start." "Changing rollers." "Continuous miner being pulled back from face." (missing)
Foot, toes	Fracture	"Reached to remove rock when wheel of add car passed over foot." "Tripped over a hose." "Unloading a flat top full of pipes." "Roof bolting." "Changing pin on staker ram." "Removing a liner plate, plate fell 50mm onto r.foot." "Changing cool sample tin." "Lowering longwall chock." "Supporting roof with a gofer on the continuous miner."
Legs	Amputation	"Cleaning grease from dragline swing." "Not known at this stage."
Legs	Fracture	"Overtaking a water truck." "Inserted a feed pipe into a hole." "Changing a heavy earthmoving tyre on 250 ton press." "Driving a Toyota home from work."
Multiple	Multiple Injuries	"Driving to work." "A sheet pile 6m in length was being lifted into place when it sli..." "Driving to work when vehicle collided with a horse." "Off siding the bolter." "Checking tension on crane being used to remove swing." "Travelling in light truck back to workshop." "Whilst driving car hit a soft spot in road." "Travelling home from work." "Returning home." "Driving home." "Normal work duties underground."