A COST ANALYSIS OF ACCIDENTS AND INJURIES IN THE OPEN CUT COALMINING INDUSTRY

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(This Project has been submitted in part fulfilment of the Master of Applied Science in Occupational Health and Safety)
ABSTRACT

Following a study of back injuries in the Queensland Coal Industry, there arose several questions that needed further research. One of these was the cost of accident and injuries, and the impact this cost would have on an organisation.

The project's research involved a comprehensive study of literature pertaining to the cost of accidents and injuries. This included both insured and uninsured costs.

The following four classifications of accidents were researched; first aid treatments; first aid doctor treatments; lost time injury cases; and equipment accident damage cases.

A coal mine was selected for the pilot study and, data was collected on the four classifications over a complete year. This means a year that has no out standing accident cases or liabilities.

The research was then considered to determine its support for the acceptance or rejection of an hypothesis which postulates that the current methods used to analyse the cost of accidents or injuries in the coal mining industry are inadequate.

As a result of the above considerations, a number of key points are put forward in support of the acceptance of the hypothesis.

The research established costs both insured and uninsured for the four classifications under review. Then a calculation of a weighted ratio of uninsured costs to insured costs was made.

The paper concludes by making certain recommendations and supporting the need for further research into accident costing within the coal mining fraternity.

Keywords: Accidents, injuries, cost, insured, uninsured, potential, first aid, equipment, lost time.
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1. INTRODUCTION

The research topic involves a cost analysis of four classifications of class II accidents and injuries in an Open Cut Coal Mining environment. The topic was selected following the completion of a study by the author to examine the aetiology of back injuries in the Queensland Open Cut Coal Mining industry from 1984 to 1989.

From this study there arose several questions that needed further analysis. One of these, was the cost of accidents and injuries and, what impact these would have on an organisation. Historically some sections of these costs have been hidden within an organisation's overheads. Although much has, and is still being done to reduce them, little effort has been made to identify and quantify them.

To assess the costs of injuries, this project was formulated to examine the current methods of cost analysis within a mine in the Queensland Open Cut Coal Mining fraternity. In addition to considering the current situation, there was the possibility of finding a better method of the costs of analysing injuries.

1.1 BACKGROUND

A search of the literature revealed several articles with varied interpretations of effective cost analysis cost methods. Most authors acknowledged that the amount of indirect costs is significantly higher than direct costs (Heinrich, 1931, Naquin, 1975, Rieke, 1945). Some believed that they are equal to or less than direct costs (Leopold and Leonard, 1987).
Although this disagreement was found, the literature suggested that there could be benefits from calculating both insured and uninsured costs. It was suggested that the employer would receive benefits from a better understanding of the cost of accidents and this would lead to a more concerted effort to reduce accidents thus, increasing productivity. The employee would benefit from a better working environment and thus experience a reduced risk of injury.

2 LITERATURE REVIEW

The literature search was initially restricted by a strict criterion of cost analysis and cost analysis models within the coal mining fraternity. The search was later widened to encompass criteria such as accident costs, occupational accident costs, accident investigations, cost benefit analysis, loss control and, the economic cost of accidents in all industries.

A search was undertaken of the computerised bibliographic databases provided by the following institutions:
* The United Kingdom's Health and Safety Executive (HSELINE),
* United States Department of Health and Human Services' National Institute for Occupational Health and Safety (NIOSHTIC),
* the U.S. Department of Labor Mine Safety and Health Department (MSHA), and
* the International Labour Organisation's International Occupational Safety and Health Information Centre (CISDOC).

The results of the literature search were limited by the
availability of translations of material from non-English speaking countries.

The literature associated with occupational injuries and their costs is both wide and varied. It is difficult to measure the extent of the costing of "occupational injuries". In fact, not all countries have statistics on this subject. Where they exist, the statistical data cannot be compared because, the definitions, the methods of reporting and, the reliability of the respective sources vary to some degree. Heinrich is considered as the pioneer of the economic study of occupational injuries. His work has largely contributed to the recognition that, "the cost of occupational injuries to organisations is by no means being covered by the compensation provided by the insuring institutions". (Heinrich, 1931) The work that he published in 1931 made a significant impression at the time. Heinrich attempted to bring out the true cost borne by organisations for occupational injuries. Figures taken from many cases enabled him to quantify what was once thought of as only a qualitative and subjective phenomenon.

Heinrich's results were based on the examination of 5,000 case files from organisations insured with a private company. His studies, and the results of interviews with staff members within the organisations, enabled Heinrich to estimate that the ratio of the indirect cost to direct cost of such accidents was 4:1. This was accomplished by setting out in a cartesian graph the points corresponding to the various pairs of values $C_0$ (insured cost) and $C_r$ (uninsured cost). Then, by calculating the mean square line by the method of least-squares (figure 1) he obtained the equation $C_r=4C_0$. (Heinrich, 1931)
This expression states that the total cost is equal to:
\[ C_T = C_D + C_I = 5C_D \]  
(1)
where \( C_T \) = total cost, \( C_D \) = direct cost (insured cost), \( C_I \) = indirect cost (uninsured cost) and, \( 5C_D \) = 5x direct cost (insured cost).

**Figure 1.**

Direct cost and indirect according to Heinrich


Andreoni suggested that, this formula has a purely statistical value and admits the existence of differences in the values of
the ratio $C_1/C_0$ which can be significant (Andreoni, 1986). This was admitted by Heinrich, and has subsequently been brought out in numerous practical applications.

Heinrich identified that the ratios between indirect and direct costs can vary, between values of less than 4 and values as high as 50 or more. This reflects the variation that can occur from one case to another. Also variations between the methods of work adopted, safety measures adopted or, in the insurance benefits paid to the injured person. Even with these variations, the fundamental principle can still be applied, that is, expressing the direct cost by a multiple of the indirect cost for an evaluation of the total cost of an injury.

Heinrich also developed two graphic illustrations of some aspects of occupational accidents and injuries that deserve mentioning (Heinrich, 1931). Both illustrations were used and are still being used in many papers, articles and popular publications.

The first illustration was that of the iceberg. The submerged part represents the indirect or invisible costs and, the exposed part represents the direct or visible costs. Heinrich related this illustration to his ratio where the invisible part was four times greater than the visible part. Authors who used this theory after him placed different values to the ratio.

The second of Heinrich's illustrations was that of a triangle, showing, one below the other, the three areas that correspond with different consequences of occupational accidents and injuries. Heinrich's triangle represented a distribution of the consequence of a particular type of
occupational accident happening repeatedly in similar conditions.

To validate this, he collected data from different organisations, for the same type of work accident. From this he found, that of the 330 cases there was one major injury, 29 minor injuries and 300 accident cases without injury (figure 2).

Figure 2.

Heinrich's triangle
(1,500 enterprises, USA, 1931)

A particular work accident repeated three times gave rise to:
- one case of major injury,
- 29 cases of minor injuries, and
- 300 no injury accidents.

(Heinrich, 1931)
Other authors viewed the triangular illustration differently to Heinrich. Where Heinrich researched one specific type of accident, other authors examined all types of accidents and injuries. They referred to the distribution by types of consequences of all kinds of accidents within the particular framework they covered.

In a paper presented to an International Shipyard Conference in 1945, Rieke used some of the theories and formulas developed by Heinrich to highlight problems in American shipyards. To find the insured costs associated with accidents and injuries he posed three basic questions to management:

1. How much time and production is lost each year at your plant?
2. How much do you spend for health maintenance of your men (sic)?; and,
3. How much does it cost you not to maintain the safety of your workmen (sic)?

From the questions Rieke posed under these headings he was able to approximate the cost in dollars and cents per $100 payroll base rate. This is shown in Table 1.

Rieke then went on to state that this was only the direct cost, and that the indirect cost is four times this figure. To clarify indirect cost he quoted work done by Scott, Clotheir, Mathewson and Spriegel who said:

"Fifteen thousand five hundred workers in industry within the United States were killed during the year 1939. This showed a decrease of 3 per cent from the 1938 record. Permanent disabilities for 1939 numbered about 50,000 and the temporary disabilities were approximately 1,250,000 for 1939. The direct cost of these accidents as measured in terms of wages lost,
medical expenses, and the overhead cost of insurance was in the
neighbourhood of $600,000,000. This direct cost is by no means the only or the major cost. H.W. Heinrich has estimated that the indirect costs of the accidents are approximately four times as great as the direct costs. Using Heinrich’s ratio of indirect costs of accidents, the total cost to industry for the accidents of 1939 would be slightly less than 3,000,000,000. This is an appalling figure, especially when it is recalled that this is largely avoidable waste in human energy and suffering.”
(cited in Rieke, 1945)

Table 1.

OREGON SHIPBUILDING CORPORATION
WARTIME EXPERIENCE

Accident Premiums (Repair Bills) paid to Oregon State
Industrial Accident Commission

With plant medical work, first-aid and safety engineering.
Without doctor’s pre-employment examination.

<table>
<thead>
<tr>
<th>Year</th>
<th>Rate per 100 Payroll Dollars</th>
<th>*Annual payment to State per employee</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 1941-1942</td>
<td>$3.75</td>
<td>$112.50</td>
</tr>
<tr>
<td>July-1942 to July-1943</td>
<td>0.93 (50% off $1.86)</td>
<td>27.90</td>
</tr>
<tr>
<td>July-1943 to July-1944</td>
<td>1.47 (25% off $1.86)</td>
<td>44.10</td>
</tr>
<tr>
<td>July-1944 to July-1945</td>
<td>1.26 (40% off $2.10)</td>
<td>37.80</td>
</tr>
<tr>
<td>Four-year average</td>
<td>1.24</td>
<td>37.20</td>
</tr>
</tbody>
</table>

*Average shipyard wage, $3000 per year

(Rieke, 1945)

Rieke concluded that statistical figures can be made to prove many things, either correctly or incorrectly. Rieke
believed that Heinrich, being an expert of some thirty years in industrial insurance, could be relied upon.

The quest for a method to analyse the cost of occupational injuries that would be more satisfactory than Heinrich's, led to the following formula being offered by Simonds (1950).

\[ C_T = C_A + C_{NA} \]  \hspace{1cm} (1)

Here \( C_T \) = total cost, \( C_A \) = insurance costs (direct costs) and, \( C_{NA} \) = uninsured costs (indirect costs), this insured and uninsured costs formula correspond respectively to Heinrich's direct and indirect costs formula without being exactly identical. This was further developed by Simonds and Grimaldi (1956).

In the development of the formula they found that the fundamental difficulty lay in the verification of the uninsured costs. Therefore, an effort had to be made to authenticate an overall value for these costs that would be as close as possible to reality. This was done by dividing the occupational injuries into several groups or classes and giving each of these an average cost. To obtain the cost of each class, the researchers had to multiply the number of cases by the corresponding average cost. The entire cost was then the accumulation of all costs for all classes.

Simonds proposed to use the following four classes:

(1) Occupational injuries called "lost-time injuries," namely those causing total temporary incapacity for work or permanent partial incapacity,

(2) occupational injuries termed "doctor injuries"
involving partial temporary incapacity requiring treatment by a doctor from outside the organisation, 

(3) injuries called first aid injuries, requiring treatment within the organisation and involving material damage whose cost does not exceed a given level with a loss of working time of less than eight hours, and

(4) material damage whose costs exceeds the level as defined in class three with a loss of working time greater than eight hours.

Enterprise records usually contain the number of cases in each class of occupational injury. To establish an average cost for these classes, the United States National Safety Council in 1950, financed Simonds to research a standard procedure and reference values for different sectors of economic activities. The procedure that Simonds came up with was adopted by the National Safety Council, and average values were then published.

In the absence of a detailed study of the subject, Simonds and Grimaldi, (1956) developed two formulas for determining the average cost of work accidents. Taking into account the four classes, the uninsured costs were given by the following formula:

\[ C_{NA} = N_1C_1 + N_2C_2 + N_3C_3 + N_4C_4 \]  

(2)

where the total uninsured costs \( C_{NA} \) is equal to the sum of the number of incidents in the four classes \( N_{1,2,3,4} \) times the cost of the incidents \( C_{1,2,3,4} \).

The formula for the total cost then becomes:

\[ C_I = C_A + N_1C_1 + N_2C_2 + N_3C_3 + N_4C_4 \]  

(3)

The benefit of Simonds' method is that it enables one to obtain an adequate approximate value of the total cost of
occupational injuries. This is because the doubts and errors that are attached to one of the average costs for one class, have no effect on the cost of other classes. This method can be used each time there can be estimated the following two variables:

(1). The number of cases in each class and;
(2). The corresponding average cost for each case.

Also, the number of classes can be different from four and, the definition of each class can be modified according to the needs of the organisation concerned.

Naquin, (1975), in his study of accident costs in the United States, outlined the effects of the iceberg theory. His paper compiled a list of uninsured costs taken from the writings of Heinrich, Simonds, Grimaldi and, contributions made by people who attended his seminars on occupational accident prevention.

The purpose for the list was two-fold: firstly, to provide a guide to those who may have the responsibility for preparing a detailed analysis of all cost of accidents; Secondly, to request all safety professionals to forward to him any other items that they perceived to be pertinent to indirect or hidden costs. A copy of Naquin's paper may be found in the Appendix B. Naquin concluded by saying;

"As for items of direct cost, the ever changing rates of compensation being enacted by the 50 States and the district of Columbia, and the ever-upward escalation of medical costs, make it very difficult to truly establish an authentic ratio of direct costs to indirect costs."(1975, p39)

This statement would still apply in most parts of the
industrial world today.

The next significant research was conducted in Britain by Leopold and Leonard. (1987) They conducted a study of workers in the construction industry. The immediate objective of their research was to derive consistent cost estimates of industrial accidents. This was achieved by investigating accidents across a wide spectrum of firms within the industry.

A sample of 2100 construction accidents formed the foundations of what was possibly the largest industry-wide assessment carried out in the English construction industry. Questionnaire surveys were undertaken with employers and injured people representing all sectors of work within the industry in all areas of Great Britain.

Leopold's and Leonard's research was aimed at drawing attention to the full array of costs, and to highlight the repercussions of accidents at all levels of the firm. The researchers had noted that such procedures had often been recommended in the past to enable employers to derive their own estimates of cost. It was seen by the researchers that from,

"The limitation of empirical work undertaken to date reflects the extent to which accident costing remains, from the employers point of view, an alien, abstract and unwieldy concept. The employer still requires the direct intervention and sustained support of an experienced researcher to enable him to participate at all in his own costing exercise. Though this may change in the future, it must be explicitly acknowledged in the design and execution of contemporary surveys undertaken in this area." (Leopold and Leonard, 1987. pp275-276)

The insured costs of the research were calculated separately from the uninsured costs. The uninsured cost
components were divided into two groups:

(1). The direct costs, those that were directly measured in financial terms and,

(2). The indirect costs which were measured first in labour time and later translated into financial equivalents.

In their research Leopold and Leonard excluded some previously traditional cost items. The costs they excluded were: management and clerical costs that did not involve overtime; and, the safety officers' time, as their primary role was to investigate accidents. The list showing the costs to employers that the researchers examined can be located in appendix C.

Tables 2, 3, 4 and 5, demonstrate the relative significance of all uninsured cost when compared with the scale of employers' liability premium within that industry in Great Britain.

The findings of the research demonstrated the wide disparity in costs between insurance, (employers liability only) and those defined collectively as uninsured costs. For example, for the firms in the industry that experienced a notifiable accident in 1981, the average insurance premium was four times greater than all combined uninsured costs associated with any one accident. This can be seen in table 2.
### TABLE 2.

**Summary results of costs in pounds sterling.**

*(Leopold & Leonard, 1987.)*

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate costs to Employers:</td>
<td></td>
</tr>
<tr>
<td>All firms total annual employers' liability premiums</td>
<td>83.1m</td>
</tr>
<tr>
<td>all firms (115,186)</td>
<td></td>
</tr>
<tr>
<td>Total uninsured costs:</td>
<td></td>
</tr>
<tr>
<td>All recorded accidents (45,868)</td>
<td>7.3m</td>
</tr>
<tr>
<td>Indirect costs of accidents to self-employed (7,500)</td>
<td>0.2m</td>
</tr>
<tr>
<td><strong>Total Costs</strong></td>
<td>90.6m</td>
</tr>
<tr>
<td>Unit costs to employers:</td>
<td></td>
</tr>
<tr>
<td>All accidents (394)</td>
<td></td>
</tr>
<tr>
<td>weighted average liability premium per firm</td>
<td>0.722</td>
</tr>
<tr>
<td>Weighted average uninsured costs per accident</td>
<td>0.160</td>
</tr>
<tr>
<td>direct costs</td>
<td>128 pounds</td>
</tr>
<tr>
<td>indirect costs</td>
<td>32 pounds</td>
</tr>
</tbody>
</table>

Note: for derivations of weighted averages see table 5.

Tables three and four isolate uninsured costs and break these down into their direct and indirect components for each level of accident severity and for each turn-over group. In every instance, direct costs dominate total uninsured costs.

Table four shows that there is a bias in this result towards firms of the largest size where direct costs per accident are virtually double those for all other turn-over groups.
TABLE 3

Average costs to employers by injury severity in pounds sterling (Leopold & Leonard 1987.)

<table>
<thead>
<tr>
<th>Injury Severity</th>
<th>Indirect Costs</th>
<th>Direct Costs</th>
<th>Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28</td>
<td>111</td>
<td>139</td>
</tr>
<tr>
<td>3</td>
<td>106</td>
<td>557</td>
<td>663</td>
</tr>
<tr>
<td>4</td>
<td>216</td>
<td>629</td>
<td>845</td>
</tr>
</tbody>
</table>

TABLE 4

Average costs to employers by turnover range in pounds sterling (Leopold & Leonard 1987.)

<table>
<thead>
<tr>
<th>Turnover</th>
<th>Indirect costs</th>
<th>Direct costs</th>
<th>Total costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 100,000</td>
<td>34</td>
<td>172</td>
<td>206</td>
</tr>
<tr>
<td>100,000-500,000</td>
<td>59</td>
<td>109</td>
<td>168</td>
</tr>
<tr>
<td>0.5m-2.5m</td>
<td>38</td>
<td>224</td>
<td>262</td>
</tr>
<tr>
<td>2.5m-10m</td>
<td>50</td>
<td>137</td>
<td>197</td>
</tr>
<tr>
<td>Over 10m</td>
<td>44</td>
<td>396</td>
<td>440</td>
</tr>
</tbody>
</table>

In an attempt to take stock of the state of knowledge in methods used by different authors, the International Labour Office commissioned further research. The study was prepared by Diego Andreoni, former Director-General of the Italian National Institute for the Prevention of Accidents (Ente Nazionale per la Prevenzione degli Infortune - ENPI) (Andreoni, 1986). In his study to find a more realistic and viable formula for costing occupational accidents and diseases, Andreoni researched the methods and theories of authors that had preceded him.
**TABLE 5.**

**All construction accidents 1981.**
Derivation of weighted aggregate uninsured costs in pounds sterling

<table>
<thead>
<tr>
<th>Number of construction accidents reported in 1981, by severity</th>
<th>Mean Value</th>
<th>Aggregate Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) 44,073</td>
<td>139.269</td>
<td>6,138,002.70</td>
</tr>
<tr>
<td>(2) 1,690</td>
<td>662.762</td>
<td>1,120,067.70</td>
</tr>
<tr>
<td>(3) 105</td>
<td>845.168</td>
<td>88,813.60</td>
</tr>
<tr>
<td><strong>Total</strong> 45,868</td>
<td><strong>845.168</strong></td>
<td><strong>7,346,813.00</strong></td>
</tr>
</tbody>
</table>

*Total uninsured for each accident severity group consists of sum of direct and indirect costs as derived in tables below.*

<table>
<thead>
<tr>
<th>Indirect costs</th>
<th>Mean Value</th>
<th>Aggregate Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) 44,073</td>
<td>28.339</td>
<td>1,248,984.70</td>
</tr>
<tr>
<td>(2) 1,690</td>
<td>106.171</td>
<td>179,428.99</td>
</tr>
<tr>
<td>(3) 105</td>
<td>216.340</td>
<td>22,715.70</td>
</tr>
<tr>
<td><strong>Total 45,868</strong></td>
<td><strong>216.340</strong></td>
<td><strong>1,451,129.39</strong></td>
</tr>
</tbody>
</table>

=31.64 pounds weighted average indirect costs per accident

<table>
<thead>
<tr>
<th>Direct costs</th>
<th>Mean Value</th>
<th>Aggregate Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) 44,073</td>
<td>110.930</td>
<td>4,889,317.80</td>
</tr>
<tr>
<td>(2) 1,690</td>
<td>556,591</td>
<td>940,638.79</td>
</tr>
<tr>
<td>(3) 105</td>
<td>628.828</td>
<td>66,026.94</td>
</tr>
<tr>
<td><strong>Total 45,868</strong></td>
<td><strong>628.828</strong></td>
<td><strong>5,895,683.53</strong></td>
</tr>
</tbody>
</table>

=128.53 pounds weighted average direct costs per accident


Andreoni (1986) examined the studies of Heinrich and his theory of four times the indirect costs for every one direct cost. He reviewed the method of accident costing put forward by Simonds and Grimaldi, and found it a more flexible formula to use than that of Heinrich.

The metal trades and the iron and steel industries were found to have done the most numerous and detailed studies of accident costing. The work of Compes (cited Andreoni, 1986)
for the metal trades, he found particularly noteworthy. Andreoni found that the work of Compes had several points similar to Simonds and Grimaldi, but diverged from it in its distribution of the elements making up the total costs. Where Simonds' and Grimaldis' total cost referred to the insured and uninsured costs, Compes looked at the common costs and, individualised costs (Andreoni, pp51-53).

Andreoni reviewed the work done by Wallach (1962) and found it dealt mainly with the effects of occupational accidents on production. He found that it had the advantage of using ideas and a language that was familiar to organisations. Thus, arousing a greater interest on the part of managements, inducing them to take steps to develop prevention methods (Andreoni, 1986. p53).

The triangle theories of Heinrich,(1959) Bird,(1966) Fletcher,(1972) and the British Safety Council,(1975) were examined. Andreoni found that as the years progressed and the data became more accurate, the theories became better defined and more readily usable. He concluded by saying that each of the triangles represented the data that applied to the cases to which they related. The indications which they gave, could only be transposed to other situations with extreme caution (Andreoni, 1986,pp48-51).

Andreoni's main study was to illustrate the distribution of the cost of occupational injuries among different members of the community, and also to put forward suggestions that would help reduce some cost elements. His classification of the costs of occupational injuries consisted of three basic elements:
(i) expenditure incurred during the production planning stage of the activity concerned,
(ii) expenditure linked with the activity itself, and
(iii) expenditure and losses resulting from the activity.

A detailed evaluation was conducted on all associated costs of accidents. The cost to the individual, organisation and, community were all investigated. From this Andreoni produced a formula that was very comprehensive.

Within the scope of the present review, it is not possible to give a full description of the work of Andreoni, which is detailed and long. The following is a brief summary of the contents of his formula.

In all cases of accidents and injuries, Andreoni had to establish the cost $C^x_1$ corresponding to the expenditures and losses incurred during a given year. He then had to calculate the cost $C^x_2$ which corresponded to the financial charges associated to the same year.

The formula for finding the cost of $C^x_2$ is as follows:

$$C^x_2 = D_c + D_{pe} + P$$  \hspace{1cm} (4)

where; $D_c =$ the planning and design expenditures;
$D_{pe} =$ the exceptional expenditure on prevention; and
$P =$ all other losses

$C^x_1$ is calculated for each class of accident using the following formula:

$$C^x_1 = D_{pf} + D_{af} + D_{pv} + D_{av} + D_l + D_e + D_{pe} + P$$  \hspace{1cm} (5)

where;
$D_{pf} =$ fixed expenditure on prevention;
$D_{af} =$ fixed expenditure on occupational injury insurance;
$D_{pv} =$ variable expenditure on prevention;
\( D_{ar} \) = variable expenditure on occupational injury insurance;
\( D_{1} \) = variable expenditure associated with occupational injuries;
\( D_{m} \) = variable expenditure relating to material damage associated with occupational injuries;
\( D_{pe} \) = exceptional expenditure on prevention; and
\( p \) = financial losses associated with production losses.

As seen by the formula, the data collection is very detailed and time consuming. Andreoni has indicated a simplification of this method by leaving out those elements of data that provide the least return for the effort expended in accumulating them.

2.1 SUMMARY OF LITERATURE REVIEWED

The results of research and the statistical data published in many countries show how difficult it is to draw up a precise list of the numerous elements that make up accident costs. While some of these elements can be isolated and quantified easily, others are much more difficult to perceive or measure precisely. Different countries and different authors use numerous methods, mathematical, statistical or, empirical, to define and assess these various elements.

Heinrich (1931) through his studies of 5,000 case files of organisations insured with a private insurance company, came to the conclusion that indirect costs were four times greater than direct costs. His research examined the total expenditure of each case.

In 1945, Rieke using some of Heinrich's theories and formulas highlighted a problem within the American ship yards.
In his research Rieke only examined the direct costs associated with the cases. To clarify the indirect proportion of his research he quoted work done by Scott, Clotheir, Mathewson and Spriegel, who also used Heinrich's 4:1 ratio.

Simonds and Grimaldi (1956) developed a formula for costing accidents by assuming that the total cost was equal to the insured and uninsured costs combined. This formula corresponded respectively to Heinrich's direct and indirect cost formula without being identical.

The fundamental difficulty lay in the verification of the uninsured costs. To achieve this they divided the occupational injuries into four groups:
* lost time injuries,
* doctor injuries,
* first aid injuries, and
* material (equipment) damage

In their work, Simonds and Grimaldi excluded class 1. type accidents (deaths and permanent disabilities). Their reason being that these cases were rare in most enterprises and that they should be the subject of a different study.

Simonds and Grimaldi developed two formulas for determining the average cost of work accidents. Taking into account the four classes, the uninsured cost was given by the following formula:

$$C_{UA} = N_1 C_1 + N_2 C_2 + N_3 C_3 + N_4 C_4$$

(2)

where the total uninsured costs $C_{UA}$ is equal to the sum of the number of incidents in the four classes $N_{1,2,3,4}$ times the cost of the incidents $C_{1,2,3,4}$. 
The formula for the total cost then becomes:

\[ C_t = C_A + N_1C_1 + N_2C_2 + N_3C_3 + N_4C_4 \]  

(3)

The benefit of Simonds' and Grimaldi's method is that it enables one to obtain an adequate approximate value of the total cost of occupational injuries. This is because, the doubts and errors that are attached to one of the average costs for one class, have no effect on the cost of other classes. This method can be used each time there can be estimated the number of cases in each class and the corresponding average cost. Also, the number of classes can be different from four and the definition of each class can be modified according to the needs of the organisation concerned.

Naquin (1975) compiled a list of indirect costs that could be examined when researching the costs of accidents and injuries. The list was compiled from the writings of previous researchers and people who attended his seminars on occupational accident prevention.

In 1986, after reviewing the studies of previous researchers, Andreoni developed a very comprehensive formula that encompassed three basic elements:

(i) expenditure incurred during production planning stage of the activity concerned,
(ii) expenditure linked with the activity itself, and
(iii) expenditure and losses resulting from the activity.

To achieve this comprehensive formula he did a detailed evaluation of all costs associated with accidents. Included in these were the cost to the individual, organisation and, community.
Andreoni's formula, while being very detailed, is, in some instances, similar to that of Simonds and Grimaldi. Where they have used the terminology "insured" and "uninsured" costs, Andreoni has used fixed expenditure and variable expenditure.

In Britain, Leopold and Leonard conducted a study of workers in the construction industry. The immediate objective of their research was to derive consistent cost estimates of industrial accidents across a wide spectrum of firms within the industry (Leopold and Leonard, 1987).

A sample of 2100 construction accidents formed the foundations of what was possibly the largest industry-wide assessment of Occupational accidents carried out within the construction industry in the United Kingdom. Questionnaire surveys were undertaken with employers and injured people representing all sectors of work within the industry and all areas of Great Britain.

Leopold's research was aimed at drawing attention to the full array of costs, and to highlight the repercussions of accidents at all levels of the firm. The researchers had noted that such procedures had often been recommended in the past to enable employers to derive their own estimates of cost. It was seen by the researchers that, from the limitation of empirical work undertaken to date, the employers still viewed accident costing as an alien abstract and unwieldy concept.

The insured costs were taken up separately from the uninsured costs. The uninsured cost components were divided into two groups. The direct costs, those that were directly measured in financial terms and, the indirect costs that were measured first in labour time and later translated into
financial equivalents.

In their research Leopold and Leonard excluded some previously traditional costs items. Two of which were, management and clerical costs that did not involve overtime and, the safety officer's time as his primary role was to investigate accidents. In a majority of the research reviewed so far, these items have been included in the studies. The reason for this is, these people have other task to perform and the amount of time taken by staff in association with injuries should be costed to that injury.

Their findings indicated that, within the construction industry in the United Kingdom, the ratio of direct cost to indirect costs was 4.5:1. This result supports the view of other researchers that, depending on the industry, country, work and, social environment, the ratio between direct and indirect costs can differ greatly (Simonds & Grimaldi 1956, Compes 1965, Andreoni 1986).

Direct costs have been considered in earlier research to be the tip of the iceberg i.e. about one fifth of the total cost to the employer (Heinrich, 1931). The National Safety Council, (1950) has reported a ratio of 1:1 between insured and uninsured costs. Leopold and Leonard, (1986) found that the difference between insured and uninsured costs had a ratio of approximately 4.5:1. Andreoni (1986) concluded that after reviewing other researcher's studies the ratio could even go as high as 50:1 indirect costs to direct costs.

The literature reviewed researches the costs of accidents and injuries in different industries in different countries. It has been confirmed by researchers such as Compes, (1968)
Simonds & Grimaldi, (1965) and Andreoni, (1986), that the
classification of accidents into groups is very beneficial when
trying to determine costs. The use of a ratio method as
developed by Heinrich (1931), can be fraught with
inconsistencies in the final analysis. Once the costs are
determined for each classification of accident, then a ratio of
direct as opposed to indirect costs can be established.

Although research has been undertaken in different
industries throughout the world, at the time of writing, no
significant research has been undertaken within an Australian
open cut coal mining environment. With this in mind and,
taking certain elements from the different literature reviewed,
the author proceeded to research four classifications of
accidents costs within the designated environment. As
previously indicated, because of time constraints, the research
will not include class one type accidents (i.e. permanent
disabilities or deaths).

It was envisaged that, at the completion of the research,
comparisons regarding the ratio of direct and indirect costs
can be made with the findings of previous studies. The
following graph indicates the ratio findings of some of the
different researchers.
2.2 HYPOTHESIS

In the Open Cut Coal Mining Industry, the indirect costs of non-fatal accidents and injuries would be significantly more than the direct costs.

2.3 OBJECTIVES

(1) To analyse the direct and indirect costs of four classifications of non-fatal type accidents and injuries within a designated Queensland Open Cut Coal Mine.

(2) To estimate the cost of first aid treatments

(3) To estimate the potential production loss due to equipment accident down time.

(4) To relate all losses to a dollar value and, estimate a ratio of indirect costs to direct costs.
2.4 SCOPE

The prime purpose of accident prevention work is to prevent personal injuries and death. The second major objective of accident prevention work is to reduce production or operating costs for the sake of profits. While second to the prevention of human injury, cost reduction broadens the basis for safety work.

Cost reduction provides a direct purpose for preventing all kinds of accidents, those that happen not to cause injury as well as those that do. Cost reduction as a purpose brings into focus the losses from property damage, interference with production, as well as purely the injury aspect. However, the stability of human resources is important for efficient production. Management must seek efficient operation if it is to manage at all. Thus, it is not surprising that history bears out the following statement made by R.B. Blake. A Senior Safety Engineer of the Division of Labour Standards, U.S. Department of Labour, Blake (1944, p14) said;

"The main driving force behind the industrial safety movement is the fact that accidents are expensive. Substantial savings can be had by preventing them."

There are two major classes of costs resulting from accidents, the insured cost and the uninsured cost. The insured cost is ordinarily available in the company records. The uninsured costs are those that are not covered by any insurances and therefore carried by companies by way of overheads. Therefore, it is the uninsured costs to the company that require the major analysis.

For a number of years, organisations within the open cut
coal mining industry have been using different methods to evaluate the cost of accidents and injuries. Some organisations in Queensland place a value of $600 per day for lost time injuries. This is based on the lost time injury plus replacement of worker and, one hour machine down time. Another method was using Heinrich's calculation, that, for every insured cost, the are four uninsured costs. Another method used in costing was to divide the amount of Workers Compensation Premium by the number of days lost through injury.

There is a need for effective cost analysis of accidents and injuries in the open cut coal mining industry. One that will validate and quantify those acceptable costs associated with accidents and injuries, and assist in the development of effective prevention and rehabilitation strategies.

Initially this study's research was to involve all areas and types of accidents and injuries within a coal mining environment. These would include first aid cases, lost time injury cases, equipment damage, compensation payouts for permanent disabilities, common law cases and fatalities. Following consultation with academic peers, it became apparent that, with the time constraints, a refining and narrowing of the study's scope was necessary.

Keeping the above requirements in focus, and giving regard to the original concern expressed by the writer, the scope of the thesis has been refined. It will now consider four main categories of class II accidents. These are, first aid cases, equipment damage, doctor treatments, and lost time injury cases. The lost time injury cases do not include class I type accidents namely, deaths, permanent disabilities, compensation paycuts or, common law cases. The reason for leaving these out
was that they should be the subject of a different study dealing with 'catastrophes'.

The above justification of scope does detract from the studies original concept. That is, finding as true as possible, the cost of accidents and injuries within an open cut coal mining environment. The above setting of parameters is necessary only to ensure that the study remains within the realms of practicality and feasibility.

3. RESEARCH METHODOLOGY AND PROCEDURE:

The information gathered for the study consisted of three basic areas.

(.1) A pilot study
(.2) analysis of data and assessment of its limitations.
(.3) Findings, conclusions and recommendations.

Each of the above will be discussed further when the information provided by them is considered. Therefore, it is sufficient here to outline how the three methods complement each other and lead towards the objectives of the research.

3.1 PILOT STUDY

A pilot study was conducted at a designated open cut coal mine. Using a complete twelve months of accident data, the direct and indirect costs were investigated. This was by way of a criteria guide formulated from the literature research. Methods used to collect the data were:

(a) Interviews with personnel from Accounting, Management, Safety, First aid and Front Line Supervision.
(b) Collection of data from first aid records, lost time injury records and equipment damage records.
(c) Case study of first aid cases over a ten week period for an estimate of time taken and cost of different injury types.

The data collected from both the ten week case study and, the full financial year, were compiled on computer disk using DBASE III PLUS. The file name for the ten week case study is A:\POSTREAT.DBF and, the file name for the full financial year is A:\POSA90.DBF. The 3.5 disk containing these files is located in appendix A.

3.2 RESEARCH AND LIMITATIONS OF DATA

This aspect of the methodology, is to analyse both the direct and indirect costs associated with the accident and injury data. This data was obtained from the designated mining environment. This also, highlights the limitations associated with the data and its collection.

3.3 RESULTS, CONCLUSIONS AND RECOMMENDATIONS

The categorisation and analysis of all data and case studies enabled the writer to:

1. define the findings of the study,
2. draw conclusions on the probable true costs of accidents and injuries, and
3. make recommendations to improve the current situation.

The research was based on the information obtained from a designated mine within the coal industry. It examines accident
data from the four categories discussed in the introduction. A criteria for the evaluation of indirect costs was formulated from the literature reviewed. This was used as a guide when the author examined the categories of lost time injuries and equipment damage.

3.4 FORMULATION OF GUIDE FROM LITERATURE REVIEW

A list of uninsured costs was developed from the literature reviewed. The initial list consisted of the following 35 items:

Wages Paid:

1. to an employee over the amount required to be paid by workers' compensation.
2. or salaries paid for time not worked on day of injury.

Cost of:

3. the inefficiency of an injured worker after they return to work either on alternate duties or their regular line of work.
4. rehabilitation of injured employee.
5. selecting and training a replacement worker.
6. of the inefficiency of the new starter on start up.
7. time lost by co-workers who stop to assist the injured worker.
8. time lost by co-workers who stop out of sympathy for injured worker.
9. time lost by co-workers Because of emotional upset (shock).
10. time lost by co-workers who stop out of curiosity.
11. time lost by co-workers who have to wait until a work team can be reorganised.
12. time lost by co-workers who have to wait until an
all clear is given after a general alarm has sounded.

13. time lost by co-worker who has to serve on an investigation committee.

14. bring medical treatment to an injured employee.

15. transporting injured employee to a medical facility that is some distance away.

16. overtime brought on because of an injury.

17. time lost by foreman or supervisor who has assisted the injured employee.

18. time lost by foreman or supervisor who has to transport injured employee to medical facilities.

19. time lost by foreman or supervisor who has to arrange for the injured employee’s work to be continued.

20. time lost by foreman or supervisor who has to investigate the injury or accident.

21. time lost by foreman or supervisor who has to write accident reports.

22. cleaning up following an accident or injury.

23. equipment that is used in recovery.

24. replacing or repairing damaged equipment.

25. lack of production if machine or equipment is made inoperable because of an accident.

26. spoiled or damaged materials and semi or finished products because of accident.

27. failure to fill orders on time because of occupational accidents.

28. loss of bonuses that could have been earned.

29. the loss of good will because of delayed shipments.

30. an employer due to provisions of employee welfare and benefits programme.

31. loss of production that arises out of any depression
of workers' morale with an attendant loss of efficiency.

32. extra costs that arise out of union-management contract bargaining that arises out of company's poor safety record.

33. lawyer's fees and other legal expenses that are incurred because of law suits that arise out of occupational injuries.

34. Uninsured cost that are not covered by a worker casualty insurance policy.

35. Penalty cost governed by any statutory body for poor safety standards.

The 35 variables were discussed with the accounting section of the organisation for validation and quantification. Of the 35 items proposed, a list of ten were chosen to be used in the study. The reason for the elimination of such a high number of variables was because of the possibility of double counting and, the cost of substantiating some variables would be more than their worth (Simonds & Grimaldi 1956, Andreoni 1986).

It was agreed that some of these ten variables may not be used in some accident cases, but were included because they were considered important. This list was then titled, Elements of Uninsured Costs, and would be used when investigating the accidents from the period in question.

The following is the list of ten variables to be used:

**ELEMENTS OF UNINSURED COSTS**

1. Cost of wages paid for working time lost by workers who were not injured.
Sometimes employees near the scene of an accident stop their work to watch or, offer assistance or, to talk about the accident. On other occasions uninjured employees are unable to continue working for a time after an accident because they need equipment damaged by the accident or, they cannot get on without the output or aid of the injured worker. This variable covers the wages paid to such employees during those periods of lost working time. It is reasonable to suppose that ordinarily an employee's work is worth at least as much to his employer as the wages he is paid for the time involved.

2. The cost to repair, replace material or equipment that was damaged in the accident.

3. Cost of wages paid for working time lost by injured workers, other than compensation payments.

4. Extra cost due to overtime worked necessitated by an accident.

5. Cost of wages paid to Supervisors while their time is required for activities necessitated by the accident.

6. Wage cost due to decreased output of injured worker after return to work.

7. Cost of learning period for new worker.

8. Uninsured medical costs borne by the company.

9. Cost of time spent by higher Supervision and clerical staff
on investigation or, in the processing of compensation application forms.
(This does not include item 5.)

10. Miscellaneous unusual costs:
This category includes the less typical costs, the validity of which must be clearly shown by the investigator on individual accident reports. Among such possible costs are: public liability; cost of renting replacement equipment; cost of hiring new employees and, demurrage (ie the hold up of transport used for transporting product or damaged machinery).

3.5 INTERVIEWS

Interviews were initially conducted with Senior Management and Union Officials to gauge the acceptance and, if any, problems and limitation of the research study.

The unions had no difficulty in accepting the research project as long as it did not infringe on the personnel aspects of the worker. This also included any information received from interviews with employees.

Senior Management had concerns with confidentiality and the legalities associated with it. Their concern was not only for the confidentiality of the organisation, but also, the employees confidentiality. This concern and the comment made by the union was addressed.

It was acknowledged that the organisation’s accident data base was very comprehensive. So, to alleviate concerns regarding the confidentiality of employees, interviews would
only be conducted with staff personnel and not wages employees. To alleviate the concern of the organisations confidentiality, all documentation had to be passed by an appointed party prior to publication.

3.6 TEN WEEK CASE STUDY OF FIRST AID CASES

A ten week pilot study was conducted to determine a number of variables relating to first aid treatments. The pilot study was conducted over a period from the 24-03-91 to 01-06-91. These variables were:

a) the amount of time spent on individual first aid treatments;
b) the amount of time spent travelling to the first aid centre;
c) the number of treatments per department;
d) the number of treatments per classification and,
e) whether the treatment was of an industrial or domestic nature.

To calculate the amount of time travelled for each treatment, the research looked at each department. These were Mining, Engineering, Coal Preparation Plant, Administration and Technical Services.

The Mining department was separated into two areas, prestrip and coal. For each of these areas, five different locations were selected and the travel time to the first aid centre measured. These were averaged to determine an approximate travel time for that section. The same method was used for the Coal Preparation Plant.

The Administration, Engineering, Mining Office and
Technical Services Departments were all in the same industrial area as the first aid centre. Therefore, it was appropriate to time how long it took to walk, as well as drive from these areas to the first aid centre.

3.7 TWELVE MONTH FIRST AID DATA

First aid data was collected for the period from July 1989 to June 1990. Using the variables defined in the 1991, ten week pilot study, this data was then grouped and classified.

3.8 LOST TIME INJURY DATA

There were 34 lost time injury cases for the 1989/90 period. Total days lost through work injuries was 684. These days only constitute full days off work, they do not include part shifts, sick leave or any other non productive day.

Interviews were conducted with the senior Safety Advisor and Supervisors involved with each lost time injury case. Using the criteria formulated from the literature review, each case was investigated to find the actual time lost by all personnel involved. The data from the interviews has been compiled in the ensuing paragraphs.

Information concerning each injury was compiled from two sources: the Interviews stated previously and, information retained on computer in the safety incident detail reports.

3.9 EQUIPMENT ACCIDENT DAMAGE DATA.

There were 43 property damage reports for the financial year of 1989/90, with an estimated value of $153,599. These
reported damage to the following pieces of property:

* 2 Loaders
* 3 Dozers
* 6 Coal Haulers
* 7 Trucks
* 14 Light Vehicles
* 3 Drills
* 3 Cables
* 1 Dragline
* 2 Fixed Plant
* 1 Environment
* 1 LV Fuel Bay

A full list and break down of the estimated cost can be found in the Appendix E. The cost quoted was taken from the yearly safety report and therefore, only indicates insured costs.

The insurance premium cost to the company for the period 1989/90 was valued at $721,252. This premium covers a wide range of items from vehicle insurance to building insurance. The premium is a one off charge from the company's head office and therefore, there are no details of how it is split up.

Investigation of the property damage reports was carried out by interviews with Senior Safety Advisor and Supervisors to ascertain the amount of time spent on investigating, report writing and, where needed, the recovery of property or equipment.
4. RESULTS

4.1 TEN WEEK CASE STUDY

Using the variables as described in section 3.6 the following results were obtained. Over the ten week period there were thirty six different types of first aid treatments. Table 6 shows the types of treatments, the number of cases, total minutes taken and, average minutes per treatment.

The thirty six treatments were then combined to a manageable number of ten variables. This was done by the types of treatments and the average number of minutes per treatment. For example; sprains, strains, laceration and contusions are usually kept in the same category and, with an average number of minutes relatively the same, these could be grouped. Table 7 shows the ten variable treatments, what combination of treatments make them up and, the average time in minutes for each variable treatment.
TABLE 6.

**FIRST AID TREATMENTS**

Total number of types of treatment by total minutes taken equaling average minutes per treatment.

<table>
<thead>
<tr>
<th>TREATMENT</th>
<th>NUMBER</th>
<th>TOTAL MIN. TAKEN</th>
<th>AVG. MIN. PER TREATMENT</th>
</tr>
</thead>
<tbody>
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<td>3735</td>
<td>43.43</td>
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<tr>
<td>NECK</td>
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<td>139</td>
<td>15.44</td>
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<td>DRESSING</td>
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<td>711</td>
<td>7.7</td>
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<td>SPRAIN</td>
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<td>18.42</td>
</tr>
<tr>
<td>STRAIN</td>
<td>26</td>
<td>446</td>
<td>17.23</td>
</tr>
<tr>
<td>LACERATION</td>
<td>39</td>
<td>777</td>
<td>19.92</td>
</tr>
<tr>
<td>CONTUSION</td>
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<td>475</td>
<td>16.38</td>
</tr>
<tr>
<td>EYES</td>
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<tr>
<td>BURNS</td>
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</tr>
<tr>
<td>B/P</td>
<td>19</td>
<td>137</td>
<td>7.21</td>
</tr>
<tr>
<td>VIRAL</td>
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<td>419</td>
<td>7.9</td>
</tr>
<tr>
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<td>21.23</td>
</tr>
<tr>
<td>ALT/DUTIES</td>
<td>2</td>
<td>27</td>
<td>13.5</td>
</tr>
<tr>
<td>RETURN/WORK</td>
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<td>118</td>
<td>16.85</td>
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<td>SUNSCREEN</td>
<td>6</td>
<td>8</td>
<td>1.33</td>
</tr>
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<td>PILLS</td>
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<td>HEARTBURN</td>
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<tr>
<td>NOSE BLEED</td>
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<td>INJECTION</td>
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<td>3.00</td>
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<td>5</td>
<td>11</td>
<td>2.2</td>
</tr>
<tr>
<td>DROPS</td>
<td>1</td>
<td>3</td>
<td>3.00</td>
</tr>
<tr>
<td>RESPIRATORY</td>
<td>1</td>
<td>60</td>
<td>60.00</td>
</tr>
<tr>
<td>RINGWORM</td>
<td>1</td>
<td>3</td>
<td>3.00</td>
</tr>
<tr>
<td>CREAM</td>
<td>1</td>
<td>2</td>
<td>2.00</td>
</tr>
<tr>
<td>FRACTURE</td>
<td>1</td>
<td>55</td>
<td>55.00</td>
</tr>
<tr>
<td>PAIN</td>
<td>1</td>
<td>9</td>
<td>9.00</td>
</tr>
<tr>
<td>RASH</td>
<td>1</td>
<td>10</td>
<td>10.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>678</strong></td>
<td><strong>10067</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Table 7.

**TREATMENT VARIABLES**

Types of treatment with average time per treatment

<table>
<thead>
<tr>
<th>TREATMENT</th>
<th>COMBINATION</th>
<th>AVERAGE TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPINAL/BACK</td>
<td>back, neck</td>
<td>41 minutes</td>
</tr>
<tr>
<td>DRESSING</td>
<td>dressing</td>
<td>8 minutes</td>
</tr>
<tr>
<td>SSLC</td>
<td>sprain, strain, laceration, contusion</td>
<td>18 minutes</td>
</tr>
<tr>
<td>EYES</td>
<td>eyes</td>
<td>11 minutes</td>
</tr>
<tr>
<td>VIRAL/INFECTION</td>
<td>infection, congestion, nausea</td>
<td>7 minutes</td>
</tr>
<tr>
<td>HEALTHSCREEN</td>
<td>healthscreen</td>
<td>19 minutes</td>
</tr>
<tr>
<td>COMPO/CONSULT</td>
<td>compo/consult, return to work, alternate duties</td>
<td>21 minutes</td>
</tr>
<tr>
<td>BURNS</td>
<td>burns</td>
<td>13 minutes</td>
</tr>
<tr>
<td>BLOOD/PRESSURE</td>
<td>blood pressure</td>
<td>7 minutes</td>
</tr>
<tr>
<td>MISC/TREATMENT</td>
<td>ears, chest pain, sunscreen, pills, lipoze, headache, heartburn, asthma hayfever, sting, nose bleed, drops injection, pain, toothache, rash, respiratory, ringworm, fracture</td>
<td>6 minutes</td>
</tr>
</tbody>
</table>

Using the method described in section 4.3, the travel time from each of the respective areas to the first aid centre can be seen in Table 8.
TABLE 8.

**AVERAGE TRAVEL TIME FOR DEPARTMENTS**

Average travel time to first aid for each department

<table>
<thead>
<tr>
<th>DEPARTMENT</th>
<th>AVERAGE TIME TRAVELLED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining Prestrip</td>
<td>45 min</td>
</tr>
<tr>
<td>Mining Coal</td>
<td>40 min</td>
</tr>
<tr>
<td>Coal Prep Plant</td>
<td>20 min</td>
</tr>
<tr>
<td>Administration</td>
<td>10 min</td>
</tr>
<tr>
<td>Engineering</td>
<td>10 min</td>
</tr>
<tr>
<td>Technical Ser.</td>
<td>10 min</td>
</tr>
<tr>
<td>Mining Office</td>
<td>10 min</td>
</tr>
</tbody>
</table>

Table 9 gives a summary of all first aid treatments for each department during the pilot study period. Listing the number of treatments, travel time, treatment time and whether they were domestic or industrial. Table 10 shows the number of treatments and total number of treatment minutes for each classification.
### TABLE 9.

**TOTAL TREATMENT FOR EACH DEPARTMENT**

Total number of first aid treatments, time taken for treatment and time taken to travel to first aid centre

<table>
<thead>
<tr>
<th>DEPARTMENT</th>
<th>TREATMENT</th>
<th>TRAVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TYPE</td>
<td>NUMBER</td>
</tr>
<tr>
<td>Mining Pretip</td>
<td>Ind 34</td>
<td>624</td>
</tr>
<tr>
<td></td>
<td>Dom 71</td>
<td>530</td>
</tr>
<tr>
<td>Coal</td>
<td>Ind 11</td>
<td>184</td>
</tr>
<tr>
<td></td>
<td>Dom 29</td>
<td>193</td>
</tr>
<tr>
<td>Office</td>
<td>Ind 7</td>
<td>174</td>
</tr>
<tr>
<td></td>
<td>Dom 5</td>
<td>168</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>157</strong></td>
<td><strong>1873</strong></td>
</tr>
<tr>
<td>Coal Prep Plant</td>
<td>Ind 18</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>Dom 34</td>
<td>516</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>52</strong></td>
<td><strong>870</strong></td>
</tr>
<tr>
<td>Administration</td>
<td>Ind 6</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>Dom 42</td>
<td>602</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>48</strong></td>
<td><strong>701</strong></td>
</tr>
<tr>
<td>Engineering</td>
<td>Ind 138</td>
<td>2493</td>
</tr>
<tr>
<td></td>
<td>Dom 268</td>
<td>3995</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>406</strong></td>
<td><strong>6488</strong></td>
</tr>
<tr>
<td>Technical Ser.</td>
<td>Ind 6</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>Dom 9</td>
<td>57</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
<td><strong>135</strong></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>678</strong></td>
<td><strong>10067</strong></td>
</tr>
</tbody>
</table>
TABLE 10.

TOTAL TREATMENT AND TREATMENT TIME

Total number of treatments and treatment time by classifications

<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>NUMBER</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOILERMAKER</td>
<td>55</td>
<td>541</td>
</tr>
<tr>
<td>ELECTRICIAN</td>
<td>33</td>
<td>270</td>
</tr>
<tr>
<td>FITTER</td>
<td>165</td>
<td>3418</td>
</tr>
<tr>
<td>MINER</td>
<td>222</td>
<td>2923</td>
</tr>
<tr>
<td>OPERATOR</td>
<td>75</td>
<td>1055</td>
</tr>
<tr>
<td>STAFF</td>
<td>128</td>
<td>1860</td>
</tr>
<tr>
<td>TOTAL</td>
<td>678</td>
<td>10067</td>
</tr>
</tbody>
</table>

Table 12 displays the number of different treatment types for each classification. The treatment variables have been abbreviated in table 11.

The number of hours worked during the time of the case study totalled 175,769. The number of employees working at the time was calculated at 485. The total cost of all materials used in the First Aid Centre for the 10 week pilot study period was $8,247. The cost of the health nurse and back up personnel on back shifts for the study period was calculated by proportioning the yearly salaries. The budgetary salary figure for the personnel involved is estimated at $52,000 per annum per person. This figure was then divided by 52 weeks and, multiplied by ten weeks to obtain an estimate of $10,000. This figure was then multiplied by 3, the number of personnel needed to cover a 24 hour period. This gave a total of $30,000 for these people over the 10 week period.
### TABLE 11.

**CLASSIFICATIONS OF TREATMENT**

Classification of treatments by abbreviation

<table>
<thead>
<tr>
<th>Classification Type</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal</td>
<td>Sp</td>
</tr>
<tr>
<td>Strain/Sprain/</td>
<td></td>
</tr>
<tr>
<td>Laceration/</td>
<td>SSLC</td>
</tr>
<tr>
<td>Contusion/</td>
<td></td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>B/P</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Misc</td>
</tr>
<tr>
<td>Viral/Infection</td>
<td>Vir</td>
</tr>
<tr>
<td>Healthscreen</td>
<td>Hs</td>
</tr>
<tr>
<td>Compensation</td>
<td>Cp</td>
</tr>
<tr>
<td>Dressing</td>
<td>Dr</td>
</tr>
<tr>
<td>Eyes</td>
<td>Ey</td>
</tr>
<tr>
<td>Burn</td>
<td>Bu</td>
</tr>
</tbody>
</table>

### TABLE 12.

**TOTAL TREATMENT TYPES PER CLASSIFICATION**

Total number of treatments per job classification

<table>
<thead>
<tr>
<th>POSITION</th>
<th>Sp</th>
<th>SSLC</th>
<th>Bp</th>
<th>Misc</th>
<th>Vir</th>
<th>Hs</th>
<th>Cp</th>
<th>Dr</th>
<th>Ey</th>
<th>Bu</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boilermaker</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>15</td>
<td>19</td>
<td>3</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Electrician</td>
<td>1</td>
<td>9</td>
<td>0</td>
<td>7</td>
<td>11</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Fitter</td>
<td>38</td>
<td>21</td>
<td>0</td>
<td>39</td>
<td>14</td>
<td>15</td>
<td>4</td>
<td>23</td>
<td>7</td>
<td>4</td>
<td>165</td>
</tr>
<tr>
<td>Miner</td>
<td>22</td>
<td>49</td>
<td>7</td>
<td>57</td>
<td>32</td>
<td>7</td>
<td>5</td>
<td>32</td>
<td>10</td>
<td>1</td>
<td>222</td>
</tr>
<tr>
<td>Operator</td>
<td>12</td>
<td>14</td>
<td>3</td>
<td>18</td>
<td>5</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>4</td>
<td>1</td>
<td>75</td>
</tr>
<tr>
<td>Staff</td>
<td>21</td>
<td>9</td>
<td>5</td>
<td>21</td>
<td>28</td>
<td>25</td>
<td>2</td>
<td>9</td>
<td>6</td>
<td>2</td>
<td>128</td>
</tr>
<tr>
<td>Total</td>
<td>95</td>
<td>106</td>
<td>19</td>
<td>147</td>
<td>94</td>
<td>54</td>
<td>13</td>
<td>92</td>
<td>47</td>
<td>11</td>
<td>678</td>
</tr>
</tbody>
</table>
Results of the ten week case study of first aid treatments indicated the need for more informative data collection. This would include, in addition to what is currently collected, Department; Section; Time in; and Time out. Collecting this information would allow for a more accurate analysis of first aid treatments.

The database showed there were a substantial amount of miscellaneous cases taking less than 5 minutes. A majority of these cases were coming from the mining department, where travel time for each visit was either 45 or 40 minutes.

The total number of hours worked during the ten week case study was 175,769. Total number of treatments for the same period was 678 and total treatment and travel time was approximately 373.37 hours. The total cost of first aid material used was $8,247.00. The total cost for nursing personnel was $30,000. The cost per treatment during the case study period is equal to the number of hours worked by the average hourly rate added to the cost of materials, divided by the number of treatments. Shown by the following equation.

\[
373.37 \times $30 \\
= $11,201 + $8,247 \\
= \frac{$19,488}{678} \\
= $28.74 \text{ per treatment}
\]

These hours worked represent different classifications of wage rates. An hourly dollar value was estimated by adding the hourly rates together and dividing by the number of job classifications. This gave an hourly rate of $30.00.
The direct cost for the ten week pilot study was $30,000, the indirect cost for this period was $19,488. The ratio of direct as opposed to indirect is approximately 1.5:1.

4.2 RESULTS OF FIRST AID DATA 1989/90 YEAR.

Following the procedure in section 4.4, the results of the tabulations of first aid data for the 1989/90 year are shown in Tables 13, 14 and 15.

Table 13 gives a total summary of all first aid treatments for each department during the twelve months under study. Listing the number of treatments, treatment time and, whether they were domestic or industrial. Unlike the pilot study, the travelling time was not recorded for the entire year. The reason for this is the data for the full year in question was taken from the daily first aid register. This register does not record travel time. An estimated travel time was calculated using the times from table 8. Because of the minimal number of first aid treatments for Technical Services, these were combined with the Mining Department. Mining travel time was then calculated taking into consideration the four areas. This gave mining an average travel time of 38 minutes.

Table 14 shows the total number of treatments and total number of treatment minutes for each classification. Table 15 displays the number of different treatment types for each classification.

The treatment variables have been abbreviated as per the abbreviations list in the pilot study in section 5.1.
### TABLE 13.

**TOTAL TREATMENT FOR EACH DEPARTMENT**

Total number of first aid treatments including travel and treatment times

<table>
<thead>
<tr>
<th>DEPARTMENT</th>
<th>TREATMENT</th>
<th>TRAVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TYPE</td>
<td>NUMBER</td>
</tr>
<tr>
<td>Mining</td>
<td>Ind</td>
<td>201</td>
</tr>
<tr>
<td></td>
<td>Dom</td>
<td>573</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>774</td>
</tr>
<tr>
<td>Engineering</td>
<td>Ind</td>
<td>432</td>
</tr>
<tr>
<td></td>
<td>Dom</td>
<td>519</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>951</td>
</tr>
<tr>
<td>Coal Prep Plant</td>
<td>Ind</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>Dom</td>
<td>173</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>285</td>
</tr>
<tr>
<td>Administration</td>
<td>Ind</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Dom</td>
<td>189</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>215</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>2225</td>
</tr>
</tbody>
</table>

### TABLE 14.

**TOTAL TREATMENT AND TREATMENT TIME**

Total number of treatments and treatment times for each job classification

<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NUMBER</td>
</tr>
<tr>
<td>Boilermaker</td>
<td>102</td>
</tr>
<tr>
<td>Electrician</td>
<td>100</td>
</tr>
<tr>
<td>Fitter</td>
<td>398</td>
</tr>
<tr>
<td>Miner</td>
<td>854</td>
</tr>
<tr>
<td>Operator</td>
<td>271</td>
</tr>
<tr>
<td>Staff</td>
<td>500</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2225</td>
</tr>
</tbody>
</table>
### TABLE 15.

**TREATMENT TYPES PER CLASSIFICATION**

**Treatment types per job classification**

<table>
<thead>
<tr>
<th>POSITION</th>
<th>Sp</th>
<th>SSLC</th>
<th>Bp</th>
<th>Misc</th>
<th>Vir</th>
<th>Hs</th>
<th>Cp</th>
<th>Dr</th>
<th>Ey</th>
<th>Bu</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/Maker</td>
<td>10</td>
<td>17</td>
<td>0</td>
<td>13</td>
<td>6</td>
<td>1</td>
<td>8</td>
<td>14</td>
<td>18</td>
<td>15</td>
<td>102</td>
</tr>
<tr>
<td>Electric</td>
<td>6</td>
<td>21</td>
<td>1</td>
<td>29</td>
<td>13</td>
<td>5</td>
<td>1</td>
<td>13</td>
<td>6</td>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>Fitter</td>
<td>40</td>
<td>88</td>
<td>12</td>
<td>75</td>
<td>29</td>
<td>9</td>
<td>32</td>
<td>54</td>
<td>53</td>
<td>6</td>
<td>398</td>
</tr>
<tr>
<td>Miner</td>
<td>66</td>
<td>145</td>
<td>56</td>
<td>225</td>
<td>116</td>
<td>27</td>
<td>38</td>
<td>74</td>
<td>92</td>
<td>15</td>
<td>854</td>
</tr>
<tr>
<td>Operator</td>
<td>19</td>
<td>41</td>
<td>38</td>
<td>66</td>
<td>19</td>
<td>13</td>
<td>10</td>
<td>30</td>
<td>33</td>
<td>2</td>
<td>271</td>
</tr>
<tr>
<td>Staff</td>
<td>29</td>
<td>36</td>
<td>42</td>
<td>211</td>
<td>63</td>
<td>35</td>
<td>10</td>
<td>31</td>
<td>11</td>
<td>2</td>
<td>500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>170</td>
<td>348</td>
<td>149</td>
<td>619</td>
<td>216</td>
<td>90</td>
<td>99</td>
<td>216</td>
<td>243</td>
<td>45</td>
<td>2225</td>
</tr>
</tbody>
</table>

The total number of hours worked during 1989/90 was 936,464 and, the average total number employed was 485. The total cost of materials used in the First Aid Centre for the financial year was $29,267. First aid requiring medical attention only accounted for four treatments and, these became lost time injury cases. Therefore, they were classified as lost time injuries and are not included in the study.

Total treatment time for the financial year 1989/90 was 586 hours and, travel time was estimated at 779 hours. This gave a total of 1365.35 hours of the total travel time of 779.53 hours the mining department had 490.2 or 66.9%.

For the year there was a total of 771 industrial treatments and, 1454 domestic treatments, giving a total of 2225 treatments. These had a total treatment and travel time in hours of 485.2 and 880.15 respectively. Domestic treatments accounted for 64.5% of all treatments.
The number of hours worked during the 1989/90 financial year was 936,464. The total first aid treatment and travel time calculated for the year represents 0.15% of the hours worked for that period. This percentage can be seen as negligible compared to the total hours worked but, on its own face value represents an estimated loss of 1365 hours (170.5 shifts). This figure has the potential of being reduced by proper managerial controls. One must point out however, that, with the high number of domestic treatments, this could have inadvertently reduced the amount of sick leave taken. These controls will be highlighted in the recommendation section of this thesis.

The cost of materials used in the First Aid Centre for the financial year was $29,267. The cost of salaries for the financial year totalled $156,000. This was the combined budgetary salaries of the health nurse and backup personnel. The cost per treatment during the financial year is equal to the number of hours worked x the average hourly rate + the cost of materials, divided by the number of treatments. This is shown by the following equation.

\[
1365 \times \$30 = 40,950 + 29,267 = \$70,217 \div 2225 = \$31.55 \text{ per treatment}
\]

The estimated total costs for the 1989/90 year for first aid was $70,217, and the estimated cost per treatment was calculated at $31.55. The direct cost for the 1989/90 year was $156,000. The indirect cost for this period was $70,217. The ratio of direct as opposed to indirect is approximately 2:1.
4.3 RESULTS OF LOST TIME INJURIES

Using the method described in section 4.5, the following results were obtained. The time taken by the Safety Advisor was included for investigation of the incident, processing of the report and follow up of any recommendations made. As stated previously, there were 34 lost time injury cases associated with the mine. There was also 5 cases associated with contractors that had to be investigated and reports compiled. A total of 84 hours of the Safety Advisor's time was consumed in investigating and reporting on the 39 lost time injury cases.

Interviews were then conducted with the Supervisors associated with the 34 mine cases. The 5 contractor cases have no further bearing on production losses associated with the mine. The reason for this was that the contractor was working in a non productive area. Supervisors lost a total of 65 hours on investigating and reporting of the 34 cases. Time lost by workers other than injured workers totalled 88 hours. The 88 hours were made up from following components:

* Worker's Time used in repairs associated with injury. 20hrs
* Worker held up waiting for assistance. 12hrs
* Worker transporting injured worker to first aid. 12hrs
* Workers assisting injured worker. 23hrs
* Call out of rescue personnel and senior management. 21hrs

Total 88hrs

Time lost by the workers in the 34 injury cases, which was
not covered by workers' compensation totalled 143hrs.

Overtime worked for the year, to cover absenteeism necessitated by accidents totalled 696hrs or 87 shifts. The cost of overtime was calculated by using the double time rate. This gave total cost of $41,760 which was 696 hours x 2 x $30 which was the hourly rate estimated previously. The overtime recorded is not an exact figure, it represents an estimated minimum time worked.

There was no way in which to gauge any reduction in output of injured worker once they returned to work, so this item was not included. No new workers were employed to cover absenteeism, and workers covering knew the operations. Non-productive work was stopped so that the absenteeism could be covered in certain areas that was not covered by overtime. Therefore no time was lost in training new employee in that area of operations.

There was no indirect medical cost borne by the company, associated with any of the 34 lost time injury cases. There were no miscellaneous unusual costs incurred by the company in relation to the 34 cases.

The premium paid to the Workers' Compensation Board for the 1989/90 year was $472,996.07. Merit bonuses paid back to the company for the same period totalled $62,909.24. This gave a premium figure for the year of $410,086.83. Workers' Compensation Board payments to employees totalled $193,752.

There were 34 lost time injury cases for the 1989/90 year. The number of person shifts lost through these injuries totalled 684. An estimated 1092 hours or 136.5 shifts were
lost by personnel involved in some way with the 34 lost time injury cases. These included time not covered by workers' compensation, interruptions to other workers, supervisor and safety advisor investigations and reports, repairs to faulty plant, overtime worked to cover absenteeism and, call out of rescue personnel. A full break down of figures can be seen in table 16.

The cost of the 34 lost time injuries was estimated by the addition of the net Workers' Compensation Premium plus, the cost of hours lost by personnel, and the extra cost added for overtime worked. This equalled, $410,086.83 + $32,760 + $21,360, giving an estimate of $495,966.83. The cost per day for lost time injuries, including the overtime worked by replacement personnel, is calculated by dividing the estimated cost by the total number of days lost. This would give an estimate of $726 per day per lost time injury.

The direct cost of lost time injuries for the 1989/90 year was $472,996 less $62,909 merit bonuses, equaling $410,086. The indirect cost for this period was $495,966. The ratio of direct as opposed to indirect is approximately 1:1.2.
<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>REASON FOR LOST TIME</th>
<th>LOST TIME HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Advisor</td>
<td>Investigation, Report writing and, follow up</td>
<td>84</td>
</tr>
<tr>
<td>Supervisor</td>
<td>Investigation, Report writing</td>
<td>65</td>
</tr>
<tr>
<td>Worker</td>
<td>Repairs to plant involved in injury</td>
<td>20</td>
</tr>
<tr>
<td>Worker</td>
<td>Held up waiting for assistance</td>
<td>12</td>
</tr>
<tr>
<td>Worker</td>
<td>Transporting injured worker to first aid</td>
<td>12</td>
</tr>
<tr>
<td>Worker</td>
<td>Assisting injured worker</td>
<td>23</td>
</tr>
<tr>
<td>Worker</td>
<td>Overtime worked 712x2 o/t rate</td>
<td>712</td>
</tr>
<tr>
<td>Rescue Personnel</td>
<td>Call out of Rescue Personnel</td>
<td>21</td>
</tr>
<tr>
<td>Worker</td>
<td>Time not covered by compensation</td>
<td>143</td>
</tr>
</tbody>
</table>

Estimated Number of Hours Lost 1092

To allow for a constant continuous evaluation of lost time injury costs, the form 55, which is used to document accidents, would need further development. By slightly modifying the form it will allow for the inclusion of time related information regarding the uninsured cost factors associated with accidents and injuries. Supervisors should be made constantly aware of the need for the correct information to be placed on the forms.
This would allow for a more accurate assessment of lost time injuries.

4.4 RESULTS OF EQUIPMENT ACCIDENT DAMAGE

The following results were achieved using the procedure described in section 4.6. The time taken by the Safety Advisor included investigation of the incident, processing of the report and follow up of any recommendations made. As stated previously, there were 43 property damage reports. Thirty seven of these belonged to the mine, while contractors had 6 which also had to be investigated and reports compiled by the Safety Advisor. A total of 94 hours of the Safety Advisor’s time was consumed in investigating and reporting on the 43 Property damage reports.

Interviews were then conducted with the Supervisors associated with the 37 mine cases. The 6 contractor cases have no further bearing on production losses associated with the mine. Supervisors lost a total of 64 hours on investigating and reporting of the 37 cases. Time lost by other workers involved in recovery totalled 228 hours. Of the 228 hours, 139 hours were overtime hours. As stated in section 5.3, the overtime figures are an estimated minimum time worked. The 228 hours contained the following components:

* Open Cut Examiner required in recoveries and investigations. 20hrs
* Workers required for recovery of property. 57hrs
* Crane Driver and dogman required for recovery of property. 32hrs
* Tradespeople required for recovery of property. 21hrs
* Machine Operators require for recovery of property. 41hrs
* Check Inspector required for investigation. 2hrs
* Senior Management required for investigation of accidents. 7hrs
* Personnel involved in repairs to Coal Preparation Plant incident 48hrs

Total 228hrs

Time loss because of production equipment down time due to accidents can be seen in table 17.

Investigation of one of the fixed plant damage reports showed that, as a result of the incident, the Coal Preparation Plant was shut down for 12 hours. All production workers at the plant were gainfully employed. It took three electrical trades workers and one trades assistant 12 hours to rectify the problem that was caused. The coal production loss was estimated at approximately 850 tonnes of product coal an hour. Which gave a total of 10200 tonnes of lost product for the 12 hours.

The loss of production at the coal preparation plant had an estimated value of 10200 tonnes of product coal with a market price of $48 per tonne. This gave an estimated total value of $489,600 for the loss.

All other property damage reports had no other miscellaneous unusual costs associated with them that could be quantified.
TABLE 17.

LOST TIME DUE TO EQUIPMENT DOWN TIME

<table>
<thead>
<tr>
<th>EQUIPMENT DESCRIPTION</th>
<th>NUMBER OF ACCIDENTS</th>
<th>DOWN TIME IN HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loader</td>
<td>2</td>
<td>242</td>
</tr>
<tr>
<td>Drill</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Coal Hauler</td>
<td>6</td>
<td>322</td>
</tr>
<tr>
<td>Truck Water</td>
<td>1</td>
<td>280</td>
</tr>
<tr>
<td>Truck</td>
<td>1</td>
<td>144</td>
</tr>
<tr>
<td>Dragline</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Dozer</td>
<td>3</td>
<td>800</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>18</strong></td>
<td><strong>1812</strong></td>
</tr>
</tbody>
</table>

The 43 property damage reports had an estimated value loss of $153,599. Six of these damage reports belonged to contractors. These had an estimated loss value of $20,500. Therefore, the mine had an estimated 37 property damage reports with a loss value after insurance of $133,099.

The insurance premium cost to the company for the 1989/90 financial year was valued at $721,252. How much of this figure covering plant and equipment damage cannot be estimated. The reason being, is that the premium is a one off charge emanating from the company’s head office and there are no details of how it is divided.

The criteria used for the lost time injury cases was also used in investigating the property damage reports. This included interviews and, the reading of computer print outs of reports.

An estimated 386 hours were lost through investigation,
report writing and, recovery of some of the 43 cases of damaged plant and equipment. Table 18 shows a full break down of the figures.

The time lost because of production equipment down time due to accidents, was estimated at 1812 hours. A full break down of this figure is in table 17.

Dozer accidents were by far the most damaging, with an estimated down time of 800 hours. This was followed by Loaders and Coal Haulers. The reason for singling out the last two pieces of equipment, is because they are used for coal extraction. Therefore, any break down in this area puts direct pressure on coal production.

The potential for lost production through equipment down time can be substantial. One realises that the questions have been put, "What loss?" "Production was met.", do arise from management. What we need to know is, what production output could we achieve if these pieces of equipment were not involved in accidents?

The research indicated there was a total of 1812 hours down time to production equipment at the mine. Five pieces of equipment have a potential production loss that can be measured to some degree. For the other two pieces of equipment a measurement of potential loss could not be satisfactorily achieved.

The ensuing paragraphs focus on the breakdown of equipment caused by human error accidents only and, an explanation of their production loss. The hourly production rates of each piece equipment was supplied by the Mining Department and, the
cost figures were supplied by the firm's Accounting Department.

During the period under research, there were 2 loader accidents, with a down time of 242 hours. Both loaders worked in the pits loading coal at a rate of 800 tonnes per hour. This gives these machines an estimated potential production loss of 193,600 tonnes. With an estimated recovery rate of 80% of product coal from raw coal this figure would then become 154,880 tonnes of product coal. The estimated price for coal during this period was $48 a tonne. This would then give these two accidents a potential production loss of $7,434,240.

For the same year there were 6 coal hauler accidents with a total down time of 322 hours. These haulers cart an average of 200 tonnes of coal an hour.

The potential production loss for these haulers would total 64,400 tonnes. Using the 80% recovery rate, this figure would then become 51,520 tonnes of product coal. This converted to dollars as before would give a potential loss of $2,472,960.

There were two dragline accidents for the year with a total down time of 7 hours. Draglines move an estimated 2,000 bench cubic metres of overburden an hour at a cost of 60 cents a metre. This then gives the draglines a potential loss of $8,400.
Drills had 3 accidents during the year in question, with a total down time of 17 hours. The drills have been estimated to drill at a rate of 35 lineal metres an hour at a rate of 50 cents a lineal metre. The total potential loss would equal $297.50. The 50 cents a meter was calculated by the technical services departments. This was obtained by dividing the cost
to drill a hole by the number of meters in the hole.

There was one accident involving a truck during the year. The potential loss of production was calculated at 200 tonnes per hour. The truck had a down time of 144 hours giving a potential loss of 28,800 tonnes of coal. With the calculation of 80% recovery and the value of $48 a tonne the potential loss for this piece of equipment would be $1,105,920.

For the same period there were 3 dozer accidents with a total down time of 800 hours and, one water truck accident, with a down time of 280 hours. As stated previously a satisfactory measurement of potential loss for these two pieces of equipment could not be substantiated. Further research would be required in this area.

For the other two pieces of equipment an estimation of potential loss could not be satisfactorily achieved.

The estimated total potential loss for the 5 pieces of equipment was $11,021,817. These pieces of equipment were involved in a total of 14 accidents, with an estimated down time of 732 hours. A total breakdown of the cost and hours can be cited in table 19.
TABLE 19.

TOTAL POTENTIAL LOSS

Potential Losses Through Equipment Down Time

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>DOWN TIME HOURS</th>
<th>POTENTIAL LOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PRODUCTION</td>
<td>$ VALUE</td>
</tr>
<tr>
<td>Loader</td>
<td>242</td>
<td>154,880 tonne</td>
</tr>
<tr>
<td>Coal Hauler</td>
<td>322</td>
<td>51,520 tonne</td>
</tr>
<tr>
<td>Truck</td>
<td>144</td>
<td>23,040 tonne</td>
</tr>
<tr>
<td>Dragline</td>
<td>7</td>
<td>14,000 BCM</td>
</tr>
<tr>
<td>Drill</td>
<td>17</td>
<td>595 lin m</td>
</tr>
</tbody>
</table>

Potential Total Monetary Loss $11,021,817.50

The direct cost of equipment accident damage for the 1989/90 year was $721,252. The indirect cost for this period was $11,660,266. This figure was calculated by adding the following costs:

* Company loss after insurance claim $133,099
* Workers' time plus overtime $15,750
* Potential product loss at preparation plant $409,600
* Potential equipment down time loss $11,021,817

Total $11,660,266

The ratio of direct as opposed to indirect is approximately 1:16.

Summary of Costs

The following is a summary of the costs associated with the three classification of accidents. As previously mentioned there were four classification, one of which was melded into
another.

The total direct cost to the company for the 1989/90 financial year was estimated at $1,287,339. This consisted of:

* Salaries $156,000.00
* Workers' Compensation Insurance premium $410,087.00
* Company Multi Insurance premium $721,252.00

Total $1,287,339.00

The total indirect cost to the company for the 1989/90 financial year was estimated at $11,660,266. This consisted of:

* Company Loss after Insurance Claims $133,099.00
* First Aid Centre Material Costs $29,267.00
* Coal Prep. Plant Loss due to accident $489,600.00
* Potential loss through equipment damage $11,021,817.00
* Working hours lost through Accidents and injuries including overtime $110,820.00

Total $11,784,603.00

This would give a potential accident indirect cost to direct cost ratio of 9.1:1.

Overall, the above information suggests that a more in-depth account of accidents and injuries, gives a better perspective to the problem of their costs.
The data provided above gives a conservative estimate of the cost of accidents and injuries, within the confines of the four classifications researched.

5. DISCUSSION

The research undertaken in this study was to investigate the cost of accidents and injuries within a coal mining environment. The subject was selected following the completion of a study to examine the aetiology of back injuries in the Queensland Open Cut Coal Mining Industry, from 1984/£5 to 1988/89. From this study there arose several questions that needed further analysis. One of these was the cost of accidents and injuries and the impact this cost would have on an organisation.

5.1 LIMITATIONS

Andreoni (1986), Simonds & Grimaldi (1956) and Leopold & Leonard (1987) put forward comprehensive formulas for costing accidents and injuries. Their formulas examined every aspect of accident costing. Their conclusions, although having been derived at by different methods, were similar. That was, with the detailed analysis of accidents and injuries, an estimate of cost could be achieved.

This project, because of limitations, could not follow the same rigorous path as the researchers discussed in the previous paragraph. Because of the time limitation placed on this project, the scope of it had to be refined. This was achieved by selecting the following four classifications of accidents; first aid cases, first aid doctor cases, lost time cases and,
equipment damage cases. The lost time injury classification would not include deaths, permanent disability or, common law cases. These four areas are consisted with research work conducted by Simonds, (1950) and later improved on by Simonds & Grimaldi, (1956).

It was found in the research that the classification of first aid doctor cases was impractical to analyse. This was because of the four cases that were sent to the doctor became lost time injuries and were recorded as such.

A point must be made now to help justify part of the research. Within the coal mining fraternity, coal mining is becoming tight, meaning, that with changes to work practices and the economic structure, increased production is required with less employees and less equipment. This puts increasing pressure onto the availability of equipment, and with this increase in pressure comes the reality of the potential losses becoming factual losses.

A potential loss, whether an enterprise wishes to recognise it or not, is just that, a potential loss. Which, given the right circumstances can become a justifiable cost burden to that company. This loss must have some recognition, the same as any other production loss that is incurred by an organisation.

5.2 DISCUSSION OF FINDINGS

The project examined the potential loss of equipment down time caused by occupational accidents. Because of the time constraints, it did not do a comparison between accident down time and that of servicing or maintenance. The author
acknowledges that this latter down time exists and is worthy of comparison. The author also acknowledges that some mines do have mechanisms in place to counteract equipment down time. Some of these mechanisms include extra equipment which is not fully utilised, stock piles of material at strategic points through out the operation.

The arguments for examining the potential loss of equipment through accident down time are varied. One is, if the accidents were reduced, or eliminated, then the need to utilise employees and equipment shifts to maintain these mechanisms could be put to the more productive use of increasing production. Another is, if a mine is working effectively because of a reduction in potential loss caused by equipment accident down time then, working hours could be reduced while still producing the same tonnage.

Further Limitations were found in several areas of the research. The main problem area being the lack of properly documented data. The system used for the reporting of accidents and injuries within the organisation, is known as a form 55. The form, in Appendix D, allows for a substantial amount of information from the accident or injury to be correlated. The problems arose when the information that was meant to be on the form, was omitted from it.

Another area that posed a limitation, was the documentation of accident down time for equipment damage. There was a difference in down time logged between the mining and engineering departments. An estimate of the down time was made by cross referencing the information obtained from both Departments.
The agreement made at the start of the research to only interview staff personnel was thought not to be a problem. This proved incorrect, as it was not possible to verify events at an accident for cross referencing. This was born out when some workers involved with different accident cases reported being involved for greater periods of time during the event.

The turn over of staff at the time of research was high because of a voluntary retirement package that was offered. This posed problems associated with the interviewing of key people involved with the accidents and injuries cases. This was partly taken care of by conducting interviews over the phone and by mail.

The present study does not seek to examine all the financial consequences of accident and injuries. It is limited to examining the losses incurred by the four classifications of accidents. It is not without interest to quote at this point the remarks made by the Confederation of British Industries in the report Safety and Health at Work, drawn up in 1974 by the committee under the chairmanship of Lord Robens.

"At the company level, if a readily applied and simple formula could be devised by which the financial loss caused by accidents and ill health could be measured, and by which inter-firm comparison within a particular industry could be made, it would make a valuable contribution towards reducing industrial accidents and occupational ill health."

(Robens Committee, 1974)

Direct costs have been considered in earlier research to be the tip of the iceberg, About one fifth of the total cost to the employer (Heinrich, 1931). The National Safety Council, (1950) has reported a ratio of 1:1 between insured and uninsured costs. Leopold and Leonard, (1986) found that the
difference between insured and uninsured costs had a ratio of approximately 4.5:1. Andreoni concluded that after reviewing other researcher's studies the ratio could even go as high as 50:1 indirect costs to direct costs (Andreoni 1986). A major number of these conclusions are shown in graph No2.

GRAPH 2.

Ratio of Direct & Indirect Costs Including Present Project

The literature reviewed researches the costs of accidents and injuries in different industries in different countries. It has been confirmed by researchers such as Compes, (1968) Simonds & Grimaldi, (1965) and Andreoni, (1986), that the classification of accidents into groups is very beneficial when trying to determine costs. The use of a ratio method as developed by Heinrich, can be fraught with inconsistencies in
the final analysis. Once the costs are determined for each classification of accident, then a ratio of direct as opposed to indirect costs can be established.

As previously indicated, because of time constraints, the research did not include all areas of analysis. It was envisaged that, at the completion of the research, comparisons regarding the ratio of direct and indirect costs could be made with the finding of previous studies.

When one examines the figures in graph 2, the ratio of the present study is more skewed towards the indirect cost than any of the previous researchers. The agreed comment made by Simonds & Grimaldi (1965), Andreoni (1986), and Leopold & Leonard (1968) that, individual analysis of accidents types as opposed to a ratio method of Heinrich, is more beneficial, would appear to be valid.

When comparing the previous research with the present study, one can see that different industries researched, produced different findings. Leopold & Leonard (1968), found that in the construction industry in England, the direct cost of an accident was five times greater than the indirect costs. They found that if any part of a construction work environment had an incident it would have little if no effect on the remainder of that environment.

The present research, after analysis, produced a ratio figure of 9:1. That is, 9 times indirect costs to 1 direct cost. This figure is double that of any previous research and, at first glance, one would be a bit skeptical in accepting it. However, it is within the broad range identified by Andreoni (1986), who said that the ratio could even be as much as 50:1.
One would ask at this point of time, "why so high a figure?" Let us now examine and compare with other research, each individual classification studied in this project.

When one examines the ratios in graph 3, it can be seen where the major influences come from. If the classification of first aid is examined separately, then the ratio of twice direct cost as opposed to one indirect cost, is more in line with that of Leopold & Leonard (1968).

The classification of lost time injuries shows a ratio of 1.2 indirect cost to 1 direct cost. This figure shows some comparison with the research conducted by Simonds & Grimaldi (1950), for the National Safety Council in America. They found by researching different classifications of incidents in a manufacturing industry the ratio of indirect to direct was approximately 1:1.

Because of the limitation placed on this project, by time and other obstructions during research, a detailed analysis of lost time injuries could not be achieved. If all aspects such as those indicated by Andreoni (1986), were analysed, then, a more accurate analysis could be obtained. If such areas as sick leave, permanent disability, deaths and common law claims were taken into account, then the indirect cost could possibly be much larger than the direct cost.

Down time caused by equipment damage has the greatest ratio in graph 3. With a ratio of 16 indirect costs as opposed to 1 direct cost, it highlights a need for concern. The major cost of this classification is the potential production loss of equipment caused by accident down time. Previous research such as that of Andreoni (1986), Leopold & Leonard (1968), make
little mention of potential production loss through down time. They may have been lower in the industries they researched. In Simonds & Grimaldi's research, they make mention of down time in the process industry. But this was insignificant due to the fact that production was held up for only half an hour at a time.

GRAPH 3.
Ratio by Incident Classification

The potential production loss, caused by the down time of equipment involved in accidents, can be significant. The author acknowledges the comment that, mechanisms can be put into place to counteract the problem. The fact still remains, that there is a potential loss to be considered. If accidents causing equipment down time can be alleviated then, the potential is minimised and production would increase.
If the potential production loss caused by equipment down time was removed from the classification, then the ratio would change considerably. This is shown in graph 4.

Graph 4.

Ratio of Costs of Classifications
(with the removal of the potential production loss)

With the removal of the potential production loss component, the equipment damage classification has a ratio of 4.8 direct costs to 1 indirect cost. The same trend can be seen in the combination of classifications. The ratio of direct as opposed to indirect is 4.7:1. This compares with the research of Leopold & Leonard (1968), who obtained a ratio of
4.5 direct costs to 1 indirect cost. It can be seen by the above discussion that different researchers, investigating cost of different industries, using different methods and, omitting or adding different factors, can, obtain different cost ratios of accidents.

The argument for the potential production loss to be included within this classification is still warranted. If a control mechanism fails or, other equipment of the same classification are indisposed for some reason, then, the potential loss becomes actual loss.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS AND THE HYPOTHESIS

The hypothesis under consideration stated:

In the Open Cut Coal Mining Industry, the indirect costs of an accident or injury, would be significantly more than the direct costs.

The results of the study held some surprises for the researcher. There were several limiting factors to contend with, those that were discussed in preceding sections and, the following.

Within the first aid research limitations were found in the area of documentation. This was noticeable when the pilot study results were used to categorise the twelve months of information from the first aid register. There was no documentation on travel time, waiting time or, whether the treatment was industrial or domestic. The later had to be
cross checked through the industrial accident report form (from here on this will be called a form 55). A copy of the form can be found in the Appendix D.

The limitations found when researching the lost time injury data consisted mainly of trying to get an accurate account from the supervisor concerned, of what transpired with the accident. Some supervisors indicated their displeasure at having to fill out the form 55 every time someone had a slight injury. A much simpler form should be investigated.

At the time of research the organisation was going through major changes. Personnel who had been with the company for several years were leaving. This added another limitation to data collection, in that some supervisor had to be interviewed by means of the telephone and post.

The equipment accident damage data had its limitations. The main one being the inconsistency between the Engineering Department and the Mining Department, on how much down time was put against the damaged machine. The same problems occurred with the interviews as it did with researching the lost time injury data. Uniform records of equipment should be kept by both departments.

**Results of First Aid Data**

Results of the ten week case study of first aid treatments indicated the need for more informative data collection. This would include, in addition to what is currently collected, Department; Section; Time in; and Time out. Collecting this information would allow for a more accurate analysis of first aid treatments.
The data base showed there were a substantial amount of miscellaneous cases taking less than 5 minutes. A majority of these cases were coming from the mining department, where travel time for each visit was either 45 or 40 minutes. First aid boxes should be carried in supervisors and Open Cut Examiners vehicles.

The number of hours worked during the 1989/90 financial year was 936,464. The total first aid treatment and travel time calculated for the year represents 0.15% of the hours worked for that period. This percentage can be seen as negligible compared to the total hours worked but, on its own face value represents an estimated loss of 1365 hours. This figure has the potential of being reduced by proper managerial controls. These controls will be highlighted in the recommendation section of this thesis.

Results of Lost Time Injuries

To allow for a constant continuous evaluation of lost time injury costs, the form 55 would need further development. By slightly modifying the form it will allow for the inclusion of time related information regarding the uninsured cost factors associated with accidents and injuries. Supervisors should be made constantly aware of the need for the correct information to be placed on the forms. This would allow for a more accurate assessment of lost time injuries.

Results of Equipment Accident Damage

The information analysed on equipment damage would suggest that a more in-depth study of the potential loss because of accidents be undertaken. The data provided gave a conservative
estimate of the cost of accidents within the confines of this classifications.

Overall the information would suggest that a comprehensive account of accidents and injuries, gives a better perspective to the problems of their costs. The data provided in the study gave a conservative evaluation of the costs associated with accidents and injuries, within the confines of the four classifications.

Based on the above indications and rationale, the research supports the acceptance of the hypothesis. Thereby confirming support for the hypothesis that the current method of costing accidents and injuries is inadequate compared to the analysis of both insured and uninsured costs.

6.2 THE OBJECTIVES AND RECOMMENDATIONS

A number of objectives were outlined in Section 1.4 of this Document. The principle aim of the study was to analyse the cost of accidents and injuries, both insured and uninsured. Obviously the considerations of the hypothesis have addressed this matter and established sufficient indications to support the argument that the present method of accident costing is inadequate.

The pertinent recommendation to come from this study is that organisations, not only within the coal mining fraternity, should put into place adequately designed accident report forms. This would allow the reporting of both insured and uninsured variables.

The objective of defining the cost of first aid treatments
was achieved to some extent, particularly in the ten week case study. This being a controlled study, all data required, was collected. Defining the cost of treatments for the full financial year provided two main areas for concern. One, insufficient information on patient identification and the second, treatment classification. The second would be looking at the number of treatments and finding what could be grouped together to reduce the number of treatment variables. It would be recommended that these two areas be placed forward for consideration.

With regards to the third objective of the study, it is recommended that research be carried out to further improve the accident report form. This would be to allow for the introduction of uninsured variables.

When defining the potential production loss due to equipment accident down time, a number of areas for further research were identified. The need for proper identification of the production losses for each different classification of machine, was evident.

Research is needed into the formulation of a report form that will allow the accurate recording of equipment down time by both, the Engineering and Mining Departments.

Relating all losses to a dollar value proved that the potential loss caused by accidents and injuries is much greater than what was first perceived. It was first thought that the ratio between uninsured costs and insured costs would be in the region of approximately 6:1. The figure established in the above study showed that the ratio was estimated at approximately 9:1.
However, more investigation and research is needed to quantify the full cost associated with accidents and injuries. The above research only investigated the tip of the iceberg, when one considers the number of variables associated with the cost of accidents and injuries to an organisation.

Whilst the research has not defined the total cost associated with accidents and injuries, it has, however, highlighted the need for other organisations within the mining fraternity to investigate their accident costs. A starting point that each organisation may find beneficial, would be the use of the criteria adopted for this study.

6.3 PROPOSED FURTHER RESEARCH

During the project certain matters were identified as appropriate for further study. In most instances these issues were mentioned during relevant discussion within the text, however, to assist in this consideration certain matters will be briefly reiterated.

For reasons of practicality the scope of the study was restricted to first aid treatments, first aid requiring doctor treatment, lost time injuries and, equipment accident damage. A number of considerations, for example long term illnesses, litigation cases and deaths, as outlined in Section 1.5 of this document have been excluded from the research. No doubt these matters are also worthy of similar attention to that which has been afforded to the subjects of this project.

The study suggests a lack of knowledge pertaining to production losses caused by down time from certain pieces of equipment. This area would be worthy of further research, in
an endeavour to give a quantitative value that could be estimated.

Throughout the project there were limitations associated with the recording of data. These mainly pertained to equipment down time and, time lost due to an accident. Further research would be beneficial in establishing a more uniform system of recording the data.

This study basically considered the cost, to an organisation, of four classifications of accidents and injuries. It in no way attempted to investigate the total loss to that organisation. This would be the nebula of a much greater research.
REFERENCES


12 Simonds, R.H. and Grimaldi, J.V., (1956). SAFETY MANAGEMENT
Accident Cost and Control. Homewood, Illinois. Richard D.
Irwin, Inc.
BIBLIOGRAPHY


APPENDIX A.

Raw Data Files on First Aid Treatments.
FIRST AID DATABASE
Use Dbase III or Excel to run data
APPENDIX B.

Copy of List of Indirect Costs by Naquin
The problems of determining what is the correct ratio of any given industrial injury to the general failure of present-day accounting systems identify all of the indirect, hidden, or uninsured costs of an injury as it can and does identify the visible Workmen’s Compensation and medical costs.”

In 1928, when the great dean of professional engineers, H. W. Heinrich, developed his history, “Foundation of a Major Injury” (the 1-29-300), he used his analysis of the 50,000 case studies he investigated and identify many of the “hidden costs” of occupational injuries.

Chapter 2, “Basic Philosophy of Accident Prevention” (Third Edition), Heinrich lists on pages 51-52 many of the factors of hidden accident costs. He said his findings for nine typical case studies, stated that it was his conviction that the “hidden” or “indirect,” or “uninsured” costs were, on the average, four times greater than the conventional accident costs arising out of Workmen’s Compensation and medical expenses.

Since at least 1963, the National Safety Council, in its annual publication, “Accident Facts,” has indicated that the “visible costs” of occupational injuries amount to equal all “other costs”—a 1 to 1 ratio. Makes little difference as to which of the above ratios is correct, for both of them are only estimations. The problems of determining just which is the correct ratio for any given industrial injury as it affects the general failure of present-day accounting systems to identify all of the indirect, hidden, or uninsured costs of an industrial injury as accurately as it can and does identify the visible Workmen’s Compensation and medical costs.

To order, again, focus attention on many of the probed items of hidden costs, the author has gathered together a list of the conventional hidden factors, as described by Heinrich, by Drs. John W. Halden and Rollin H. Simonds (see pages 79-137 of their excellent volume, Safety Management) and from the contributions made by others who in recent years have attended the author’s seminars on “Occupational Accident Prevention” at Tulane University, and at the annual short courses “Fundamentals of Occupational Safety and Health” held at Louisiana State University in Baton Rouge. Here is the list:

Some known indirect, hidden, or uninsured occupational accident-injury cost items

1. Wages or salaries paid to injured employees over and above the amounts required to be paid under the provisions of a state Workmen’s Compensation act. (Many companies find it advisable about the author

Arthur J. Naquin, a graduate mechanical-electrical engineer (Tulane ’24), is a Registered Professional Engineer (Louisiana). During the last 27 of his 42 years’ employment by New Orleans Public Service Inc., he served as the company’s Safety Counselor and Head of the Safety Department.

During his professional safety career, he has served as General Chairman of the Accident Prevention Committees of the Edison Electric Institute and the Southeastern Electric Exchange; as General Chairman of the Transit Section of the National Safety Council; as General Chairman of the Council’s Motor Transportation Conference; as President of the Southern Safety Conference, the Louisiana Safety Council, and the Metropolitan New Orleans Safety Council.

He has served both as President of the Louisiana Chapter and as National President of Veterans of Safety International. Mr. Naquin was the founder Chairman of the New Orleans Chapter of the American Society of Safety Engineers. He has also served as President of the Delta Safety Society of New Orleans, which he helped found. For a number of years, he was a member of the Board of Directors of the National Safety Council.

He was the recipient of the Louisiana Engineering Society’s Andrew M. Lockett Civic Activities medal, and the Browne-McGharty Safety Trophy. He was one of the first eight members of ASSE to be elected Fellow, and one of the first 100 persons to be certified by the national Board of Certified Safety Professionals. For the past 25 years, he has served as Director of the Industrial Division of the Metropolitan New Orleans Safety Council; for the past 21 years as guest lecturer on Safety at Louisiana State University (Baton Rouge), and for the past seven years as instructor in Occupational Accident Prevention at Tulane (University College).
from an employee-relations point-of-view NOT to
curtail a worker's take-home pay during the period
the employee is disabled).

2. Wages or salaries paid for time not worked
on the day of the injury.

3. Cost of the inefficiency of an injured worker
after he returns to work on either a "modified (light)
duty" job or to his regular job.

4. Cost of vocational rehabilitation of an injured
employee.

5. Costs of selecting and training a replacement
employee if injured's production schedule must con-
tinue. This may not amount to very much if an al-
ready qualified employee can be shifted to the in-
jured's job.

6. Cost of the "start-up" inefficiency of a replace-
ment employee. Again, this may not be a sizable
item.

"Many companies find it advisable from an employee-rela-
tions point-of-view not to cur-
tail a worker's take-home pay
during the period the employee
is disabled."

7. Costs of time lost by an injured's co-workers
who stop work to:
Assist the injured by rendering first aid or by trans-
porting injured to a medical facility.

Out of sympathy for the injured.
Because of emotional upset (shock).
Out of curiosity.
To "loaf" (while supervision is busy assisting in-
jured worker).
To wait until a work team can be reorganized.
To wait until an "all clear" signal is sounded fol-
lowing a general alarm.

To serve as a member of an accident investigation
team or committee.

8. Cost of bringing medical treatment to an in-
jured employee, or

9. Costs arising out of the need to transport an
injured worker(s) to a medical facility from a fairly
far-away point such as an off-shore drilling platform,
the transportation to be effected by helicopter, crew
boat, or ambulance.

10. Costs of overtime brought on because of an
accidental injury.

11. Costs of curtailed production efficiency of
foremen, supervisors, and other management and
staff personnel while they are engaged in:

Assisting injured employee(s). Getting him (or
her) to a medical treatment facility.

Arranging for injured's production to be con-

Investigating the cause or causes of the accidental
injury. This may involve the taking of one or more
photographs of the scene of the injury; the produc-
tion of scale drawings; the preparation of a written
report.

Preparing the required accident-injury report,
including those required under the provisions of the
federal Occupational Safety and Health Act.

Notifying the Regional Office of the U. S. Depart-
ment of Labor-OSHA of the accidental injury if such
notification is required.

Attending such hearings as may be called to in-
vestigate the accident.

Arranging for the selection and training of a re-
placement employee if the severity of the injury
requires that this step be taken.

Arranging for the selection and training of new
personnel caused by the resignation(s) of injured's
co-workers; the resignations being induced by the
occurrence of one or more occupational injuries.

Calling on members of the injured's family, if this
step is indicated.

Cost of visiting injured employee, if this step is
indicated.

Assisting the company's legal department, if an
tort suit arises out of the accidental injury.

12. Cost of cleaning up following an accidental
injury.

13. Cost of repairing or replacing damaged
machines or equipment.

14. Cost of the lack of production if machines,
tools, or equipment are rendered inoperative be-
cause of an occupational injury.

15. Cost of spoiled raw materials and semi-
finished or finished goods and products.

16. Cost due to failure to fill orders on time
(penalties, forfeits).

17. Loss of bonuses that could have been earned
for ahead-of-time delivery of goods, materials,

equipment, etc.

18. Costs that arise out of the loss of good will as,
for example, the reluctance on the part of a pur-
chaser to continue placing orders with a firm whose
occupational injuries delay promised shipment.

19. Cost to an employer due to provisions of em-
ployee welfare and benefit programs.

20. Costs that arise out of any depression of
workers' morale with an attendant loss of ef-
ciciency.

21. Costs that arise out of labor-management
contract bargaining that arise out of a company's
poor safety record.

22. Costs of attorneys' fees and other legal ex-
penses that are incurred because of tort suits that
arise out of an occupational injury.

23. Uninsured medical costs not covered by
workmen's casualty insurance policy.

24. Penalty costs assessed by OSHA compliance
officers because of violations of provisions of the
federal Occupational Safety & Health Act which are
all cost items that can be identified as being associated with some particular occupational injury. Such an analysis could be very helpful when safety professionals are preparing their annual safety department budgets. Such an analysis could be very helpful in convincing management that a certain safety practice should be instituted.

2. To request all brother safety professionals to forward to the writer all other indirect accident cost items not listed above and, which their experience has shown are pertinent hidden-cost items.

As for items of direct cost, the ever-changing rates of compensation being enacted by the 50 States and the District of Columbia, and the ever-upward escalation of medical costs, make it very difficult to truly establish an authentic ratio of direct costs to indirect costs. Nor, is it necessary. What is desirable is the reduction of the frequency and severity of occupational injuries to a 0.00 rate.

It can be done and has been done by countless firms and corporations. The safety professional should keep this objective ever in mind. -PS-

D. Burns dies

D. Burns, Professional Member of the Central Pennsylvania Safety Association of Pennsylvania, died Oct. 14. He was Safety Director for Keystone Building Construction and was a member of the 50th Safety Conference and 50th Safety Council. He had served as Secretary and Vice-President of the Central Pennsylvania Safety Conference and was currently Assembly Chairman.

Mr. Burns served as Safety Director on projects such as the New World's Fair, St. Lawrence Sea-Way, and the Niagara Power Project. He is survived by his wife, three daughters and six sons.

Technical literature

A full gamut of effective loss control programs that can be structured, refined, or expanded to meet the safety management requirements of all types of commercial, industrial, educational enterprises is covered in "Loss Prevention in the OSHA Era" by Charles Binford, former (a member of the Society's Arizona branch), and Z. A. Prust (McGraw-Hill, $11.50; 208 pages).

A practical work shows the reader how to set up a successful safety management program, to develop the necessary skills of supervision, provide engineering assistance where necessary, and measure performance. The relating of loss occurrences, identification of trends, and the installation of "standard procedure instructions" that emphasize the required methods for controlling specific job conditions and work practices, are featured.

From fire control to guarding equipment, this comprehensive book describes how to minimize and control all kinds of company losses. In the section covering policies and procedures, the reader learns how to organize the relevant information into a cohesive system that will function well in a particular firm's framework. Specific technical data needed to implement individual policies are supplied as are practical tips on employee psychology, delegating responsibility, and management participation.

Forklift Safety Training Program

A complete package containing posters, student and teacher manuals, promotional buttons, decals and more accompany the film for a total forklift driver training program. This valuable safety training film depicts the thirteen most common dangers facing the forklift driver - and the thirteen ways to avoid them. This program has proven to be as effective in small companies, with one or two operators, as in large corporations with fleets of lift trucks and hundreds of operators.

If the forklift is part of your business, then you must preview this film!

$50.00 The three-day EXECUTIVE PREVIEW is for decision-making executives. If you decide to purchase or rent later, the preview charge will be applied to the total.

$167.50 The two-week RENTAL PLAN includes the Devil's Game film, plus complete Motivational Kit. The film must be returned, but the Kit is yours to keep.

$395.00 PURCHASE the film and complete Motivational Kit.

WRITE OR CALL
MR. JAMES B. BENNETT, III
(215) 855-9750

P.O. Box 337,
Montgomeryville,
Pa. 18936
APPENDIX C.

List of Cost To Employers.
Copy of List of Costs to Employer Examined by Leopold & Leonard
Cost to Employer

I. Lost Labour

1. Length of time work interrupted immediately following an accident
2. Duration of delayed production on site, including knock-on effects of the accident
3. Extent of remedial work caused by the accident
4. Workers' time spent accompanying IP to hospital or to GP
5. Workers' time involved in follow-up investigation
6. Overtime imposed on clerical staff
7. Overtime imposed on management

II. Direct Costs

A. Continuing payments to IP after accident
   1. Wages to the end of the working day on which the accident occurred
   2. Daily payments made during absence from work
   3. Weekly holiday stamps paid during absence from work
   4. Lump sum ex gratia payments

B. Insurance Costs
   1. Estimated increase in liability premium arising from accident

C. Damage to Equipment
   1. Amount of damage not claimed on insurance
   2. Cost of repairing/replacing/rehiring equipment net of final insurance settlement

D. Legal Costs
   1. Cost of legal council
   2. Cost of expert witnesses
   3. Cost of employees testifying in court
   4. Other legal costs
APPENDIX D.

Form 55.
**NEWLANDS COAL PTY. LTD.**  
**ACCIDENT – INCIDENT REPORT**

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<th>INCIDENT POTENTIAL</th>
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<th>DATE &amp; TIME REPORTED TO SUPERVISOR:</th>
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|          |       |     | ROTATING  | OVERTIME |}

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**Describe briefly but clearly, events leading up to incident:**

**Sketch if Required:**

*IF INCIDENT POTENTIAL IS MARKED MINOR, SIGN HERE AND RETURN TO MANAGER.*
APPENDIX E.

List of Breakdown of Accident Damage and Cost.
## PROPERTY DAMAGE 1989/90

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<td>Environment</td>
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**Total** $153599