

# **Accidents - The Total Cost**

## **A Guide for Estimating The Total Cost of Accidents**



**Mine Safety and Health Program**

**Colorado School of Mines**

**Golden, CO 80401**

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By

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July 24, 2011

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## **Acknowledgements**

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Other individuals who contributed to this document through reviews / comments included: Hugh Miller, Ph.D., CMSP, Colorado School of Mines; Larry Grayson, Ph.D., CMSP, The Pennsylvania State University; and Linda Lake, Liberty Mutual Insurance Company. Additionally, appreciation is extended to Christine Geier, CSM Undergraduate Student, for her graphic art contributions.

## **Disclaimer**

This material was produced under grant number 1 R25 OH008319-02 from the National Institute for Occupational Safety and Health. It does not necessarily reflect the views or policies of the U.S. Department of Health and Human Services, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

## **PREFACE**

This publication is an aid for mining professionals engaged in the management of workplace accident costs. It presents an approach to the assignment of full company-controlled monetary costs to accidents, thus enabling these costs to be recognized and better controlled. As an additional benefit, non-monetary costs such as human suffering and environmental damage may also be controlled.

## **ABSTRACT**

The purpose of this guide is to allow mining companies to estimate the total cost of accidents using both visible and hidden costs. *Visible costs* are those costs that management readily associates with an accident, while *hidden costs* are those costs directly attributable to an accident that are not readily recognized. Even though the magnitude of the *hidden costs* associated with a specific accident may be considerably greater than that of the *visible costs*, these hidden costs are often difficult to calculate due to the challenges associated with determining a dollar value for certain consequences and the way accident costs are typically tracked in conventional accounting practices. This guide provides techniques that are useful in identifying and quantifying hidden costs. This guide will also be useful for internal applications, such as for lobbying support for a stronger safety and health program, and may also be used in conjunction with an appropriate financial analysis tool to measure the effectiveness of safety and health programs.

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# ACCIDENT PREVENTION

One of the many challenges confronting safety and health professionals is the ability to translate the total cost of every accident, including the visible and hidden components, into a meaningful value that will measure safety and health performance. One way this can be accomplished is by including all known costs in reports and other communications to managers and supervisors, and through education/training exercises that are specifically oriented towards mine supervision and leadership. According to the American Society of Safety Engineers, every \$1 spent on prevention can lead to \$3-6 in loss avoidance [ASSE, 2010].

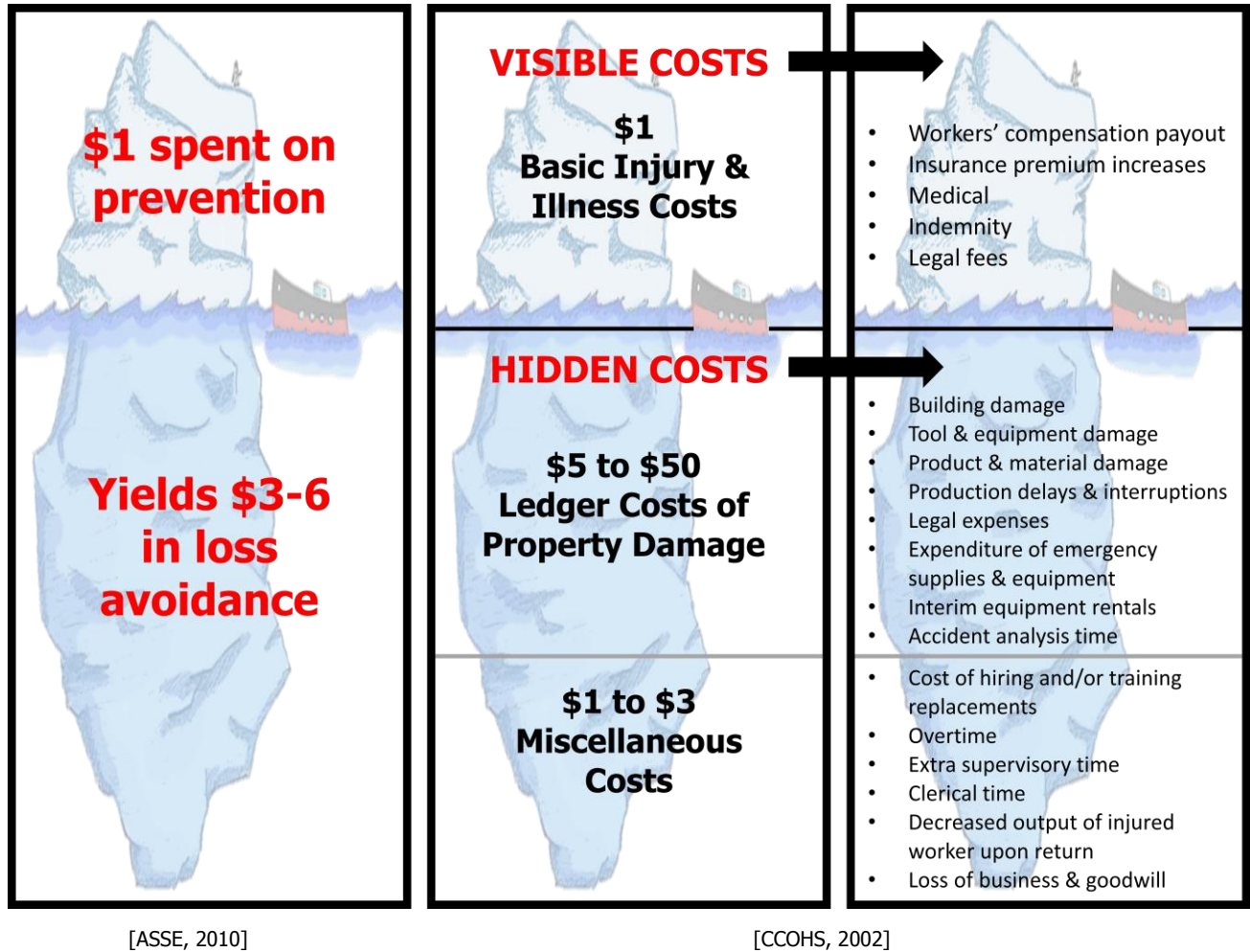


Figure 1. Accident Cost Iceberg

Because accident expenses are often *trailing* (reactive) indicators of safety and health performance, it is difficult to effectively manage these costs. If the total cost of an accident were quickly made known to those in charge, it would be easier to gain support to fund accident prevention efforts which would minimize the effects of accidents that do occur. These prevention expenses and efforts are considered *leading* (proactive) indicators of safety and health performance. Both leading and trailing indicators should be used in measuring safety and health performance so that a return on safety and health investments can be accurately estimated.

## **Leading Indicators**

Accident prevention costs are fixed costs of safety and health programs and activities that are in place to prevent and mitigate the effects of accidents. Investment in accident prevention is a basic expense most companies believe is a necessary part of business. How much to spend beyond merely complying with applicable regulations, however, can be a reflection of the company's commitment to providing a safe and healthy workplace for its employees. Although there is a diminishing return on investment in the following accident prevention areas, each has the benefit of avoiding or lessening the loss due to accidents.

### Accident Response Programs

Resources spent training and pre-planning for accidents. This includes mine rescue training, purchase of equipment, and emergency response planning.

### On –Site Medical Services

Expenses used for maintaining medical care facilities and personnel on the property.

### Inspections and Audits

Resources invested to conduct safety and health inspections and audits, as well as time spent evaluating and implementing safer processes, procedures, and work practices.

### Self-Insured Fund

Cash reserves set aside for accident expenses not covered by insurance.

### Basic Insurance Premiums

Premiums for workers' compensation, liability (casualty and fire), equipment breakdown, and other required insurance. These would be the minimum premiums charged based on a good loss record.

### Safe Design

The cost of safety and health items not required for production but necessary for accident prevention. These items may include rescue chambers, dilution ventilation, operator isolation, road berms, multiple entries, seatbelts, and other site-specific accommodations.

Other costs that may be associated with accident prevention include:

- Safety personnel and staff, including their continued training and professional development,
- Personal protective equipment programs,
- Regulatory compliance activities, and
- Legal counsel (advice).

## **Trailing Indicators**

Since accident costs are trailing indicators of safety and health performance, should an accident occur, it is important to make sure that accurate and complete data is used to



determine the total cost of the accident. This information can help decision makers establish the appropriate amount of expenditure the company is willing to pay for accident prevention. It is also important to ensure that accident related cost items are not “double counted” by appearing in more than one accounting category. To assist with the identification of these cost items, it is helpful to first understand the financial accounting system of the company. For example, the following universal classes of accident costs are suggested [Aaltonen, 1996]:

- Lost work hours,
- Lost assets (both current and fixed),
- Short-term payments (equipment rental and contractor support),
- Lost revenue and production, and
- Other (including delayed payments such as long-term payments, delayed health payments, insurance premium adjustments and some legal fees).

# WHAT IS AN ACCIDENT?

An accident is any unexpected or unplanned event that causes a loss of production, harm to people, damage to property or extended costs [Grayson, 2001]. Many companies also include harm to the environment where resources are required as a loss. Have you ever wondered how much an accident actually costs a company? Unfortunately, there is no easy way to find out, but like any other expense, the cost of a workplace accident affects a company's bottom line. Whether we like it or not, accidents are more expensive than many of us realize due to hidden costs. Visible costs such as medical expenses, costs to replace equipment, fines and penalties are easy to find and calculate, but it is not easy to find information necessary to calculate the hidden costs not directly associated with the accident, such as the cost to train and compensate a new employee, investigate the accident or implement corrective action. Due to the nature of hidden costs, many of them may not be obvious to those responsible for deciding how much to spend for accident prevention. Regardless, there must be a connection between an accident and **all** of the costs that result from it. If the total cost is more closely known, a company can make more informed decisions of how much to spend to minimize future accident costs. As a resource to safety and health professionals, this publication will present a *basic* procedure that attempts to identify all of the costs associated with an accident.

## Accident Costs

Throughout this publication, the terms *hidden* and *visible* will be used to describe accident costs. Categorizing accident costs into visible and hidden is a way of determining which costs are currently recognized as accident-related by corporate management and which costs must be determined and reported in order to provide the total cost of an accident.

Other terms have also been used to describe the same type of accident costs. For instance, costs may also be referred to as financial and lost opportunity costs, or direct and indirect costs.

Financial and Lost Opportunity. Financial costs are costs a company must pay as a result of an accident and may include overtime payments, repair costs, cost of extra materials, fines, and penalties. Lost opportunity costs include those costs associated with labor paid for no production, such as salary costs of employees waiting to work, employees at home unable to work while injured, and costs for machinery running idle [Health and Safety Executive, 2007]. Lost opportunity costs also include production and resource losses due to interruptions in the production cycle, the inability to mine previously identified mineral resources and reserves, and the delay of converting mined material into revenue through sales or other types of financial transactions.

Direct and Indirect Costs. A direct cost is a cost that can be easily and conveniently traced to the accident such as medical expenses and indemnity payments while an indirect cost is a cost that cannot be easily and conveniently traced to the particular accident such as the salary of the person investigating the accident. The terms direct and indirect have generally been abandoned in favor of other more objective terms [Hagan, 2001].

Whether a cost is visible or hidden is not as important as accounting for all of the costs associated with the accident. Figure 1 illustrates examples of both visible and hidden costs.

## **Accident Cost Resources**

There are two main resources that are used to determine accident costs: accounting systems and insurance coverage. Unfortunately, these two resources complicate the process for determining accident related costs as they cause many costs to be hidden, thus requiring the use of other resources to establish the total cost of an accident.

Insurance coverage has caused many of the accident costs to be hidden because most insurance coverage places an emphasis solely on insurance-based consequences such as bodily harm and property damage which leaves many accident costs unmanaged. On the

other hand, using an *activity-based* consequence approach will include management of the visible as well as the hidden costs because this approach looks at the broader cause and effect relationship of an accident.

Accounting systems have also caused many accident costs to be hidden as a company's accounting procedures often determine whether a cost is directly attributed to the accident or placed in another category. Therefore, assignment to one category or another is not always the same among different companies [Dorman, 2000]. In addition, the amortization and disbursement of these costs between different categories will often disguise the magnitude and true value of these costs items. In general, hidden costs are reported by accounting systems, but they are typically in some category other than "accident."

While it is impractical to assume that a safety and health professional can influence or facilitate a major change in a company's accounting practices or insurance coverage, it may be possible to establish general administrative procedures that would allow safety and health personnel to track the visible cost components over time, as well as provide a means of estimating the likely influence of hidden costs.

Table 1 provides a suggested list of cost elements that may occur for a typical incident, suggested sources that may provide actual information regarding the quantity and unit cost of each item, and references that may be used to derive typical values for the estimation of quantities and unit costs. Each cost item presented should fit into one of the above listed classes, depending on a company's accounting methods. Whether an item is visible or hidden will be organization dependent. Therefore, this list can be modified into a specific data collection form for a particular organization. Figure 1 provides an example of an Accident Cost Worksheet, which demonstrates how the cost items may be recorded for each appropriate class.

Table 1 - Cost Items and Sources of Information

Cost Item	Definition	Sources of Information
Uncompensated Wages Paid For Lost Time Worker(s)	The wages paid for time the worker(s) was not able to work, including waiting time for worker's compensation.	Supervisor's reports; interviews with worker(s), witnesses and first responders; timesheets; payroll records; insurance contracts and reports; state workers' compensation agency.
Wages of Idle Workers	The wages paid for the combined time that other workers were not producing. They may have been helping with recovery of the accident and/or their work areas or equipment were not usable.	Supervisor's reports; interviews with workers and other witnesses; timesheets; payroll records.
Lost Product	The value of product not generated because of the accident. (i.e., unable to access site due to highwall failure). Loss that cannot be made up.	Supervisor's reports; production and operating cost statements.
Property Damage Repair and Replacement	The cost of immediate repairs to damaged equipment to make it operable or the cost of replacement in the case of a total loss. The cost of delayed repairs to or early replacement of damaged equipment if it is not immediately clear that it is accident-related. This would include extra maintenance or early retirement of equipment.	Shop repair and maintenance records; insurance contract and reports; purchasing records; mining cost services.
Lost Reserves	Reserves made unobtainable for reasons created by the accident.	Mine planning/engineering.
Distributable Expenses During Idle Time	The cost of utilities and facility maintenance while in non-producing mode.	Accounting.
Accident Response Operations	The cost of time and materials expended in accident-response activities such as mine rescue, fire fighting, site recovery, ambulance services, and/or first aid.	Interviews with responders; purchasing records.
Lost Sales	The value of sales lost due to accident.	Accounting; sales department.
Recovery of Work Site	The cost of time for which workers were paid to get the work site back into productive condition or to retrieve worker(s) or equipment. May include reconstruction of access or moving of material or equipment.	Purchasing records; timesheets; payroll records.
Recovery of Lost Product	If lost product is recovered, the cost of overtime hours, temporary help or workers reassigned, and rent of equipment to recover the lost product.	Purchasing records; timesheets; payroll records.
Replacement Worker Expenses	The cost of hiring and training replacement workers.	Personnel interviews; purchasing records.
Demurrage	The cost of holding up deliveries.	Purchasing and accounting records.
Penalties	In the case of a violation, the amount of MSHA, EPA, state, county or other regulatory agency penalties paid.	Accounting.
Interest Paid On Delayed Medical Claim/Property Damage Compensation	The interest paid on money paid on a claim until the money is reimbursed.	Accounting records

Table 1 - Cost Items and Sources of Information (Cont.)

Cost Item	Definition	Sources of Information
Uncompensated Medical Expenses	The value of medical expenses other than deductibles or excess claim payments that is not reimbursed by insurance. This includes mine dispensary costs and the cost of non-emergency transportation to and from a medical provider.	Insurance contract and reports; personnel interviews and records; state workmen's compensation agency
Insurance Deductible	The amount of a claim that must be paid by the company before compensation takes effect.	Insurance contract and reports; state workmen's compensation agency
Excess Claim Payments	The amount paid by the company over and above insurance coverage limits.	Insurance contract and reports
Liability Paid	The uninsured amount paid in third-party or non-mine liability claims.	Insurance contract and reports
Investigation Time	Cost of time spent investigating the accident, including in-house investigations and MSHA investigations.	Investigation report; interviews; timesheets
Interview Time	Cost of time spent interviewing workers and witnesses.	Investigation report; interviews; timesheets
Meetings to Discuss Accident	Cost of time spent in special meetings discussing the causes and lessons of the accident.	Interviews; timesheets
Report Preparation Time	Cost of time spent preparing investigation reports.	Interviews
Claims Paperwork Time	Cost of time spent preparing and filing claims paperwork.	Interviews
Legal Fees Not Reported Elsewhere	Fees paid for legal assistance.	Accounting
Outside Consultant Fees Not Reported Elsewhere	Fees paid to outside specialists for technical assistance. (i.e., expert witnesses)	Accounting
Insurance Premium Adjustment	Differential in future insurance premiums caused by this event.	Insurance carrier
Harm to Reputation and Morale	A non-quantifiable cost manifested in lower efficiency and increased difficulty in obtaining workers and new contracts.	Subjective estimate
Lost Productivity	Cost of lower productivity due to using inexperienced replacements	Subjective estimate
Product Replacement	If the product is sold at a price specified in a contract and the operator is unable to produce the product, it may be necessary to purchase the product from another producer at a higher price to meet the delivery specifications of the contract (i.e., Coal on the spot market).	Purchase and sales records

Accident Cost Worksheet					
<b>Unit/Department</b>					
<b>Date and Time of Accident</b>					
<b>Description of Accident</b>					
<b>Investigator</b>					
COST CLASS					
<b>Item/Activity</b>	<b>Sub-item/activity</b>	<b>Units/Hours</b>	<b>Unit/Hourly Cost</b>	<b>Item Cost</b>	<b>Data Source</b>
<b>Total Cost</b>					

Figure 2. Sample Accident Cost Worksheet. An accident cost worksheet designed for a mining operation should include basic information regarding the event and the following elements: cost class, item or activity, duration of activity, units of item, wage/salary rate or unit cost, and total cost of the item or activity. A rate or cost amount should be as accurate as possible, but many times may be an overall estimate. Design of this form would be specific to the company where these accounting categories attach to a given event.

# **ACCIDENT COST DETERMINATION PROCEDURE**

A total cost estimate of one or more accidents may demonstrate whether current accident prevention expenditures are achieving a satisfactory level of safety and health performance. Because determining actual accident expenses may be a time-consuming task, a systematic approach to gathering the necessary data is of great benefit. The systematic approach presented below will strive to identify and assign a cost to all activity based consequences of the accident through three steps: 1) Event description, 2) Accident consequence tree and 3) Cost calculation.

## **Event Description**

First, the event must be defined by start time, end time, location, and all information relevant to the consequences of the event. The start time is when the normal process is interrupted and the end time is when the normal process resumes. Once the event is defined, then the consequences and their component activities may be assigned to the event.

## **Accident Consequence Tree**

Similar to the way a fault tree is used to analyze the causes of an accident by reasoning backward from the event, an accident consequence tree can be constructed to analyze the consequences of an accident by reasoning forward from the event [Rikhardsson, 2006]. Consequence tree construction is a logic process that produces a diagram displaying all possible consequences of a particular undesired event. The process begins with the undesired event at the top of the tree. Reasoning forward from the undesired event, the events that could directly result from the undesired event are shown immediately below. Each primary consequence is analyzed to determine its consequences. The logic process continues for each consequence identified. An example of an Accident Consequence Tree is shown in Figure 3. An actual tree may have a complete set of primary, secondary, and subsequent consequences.



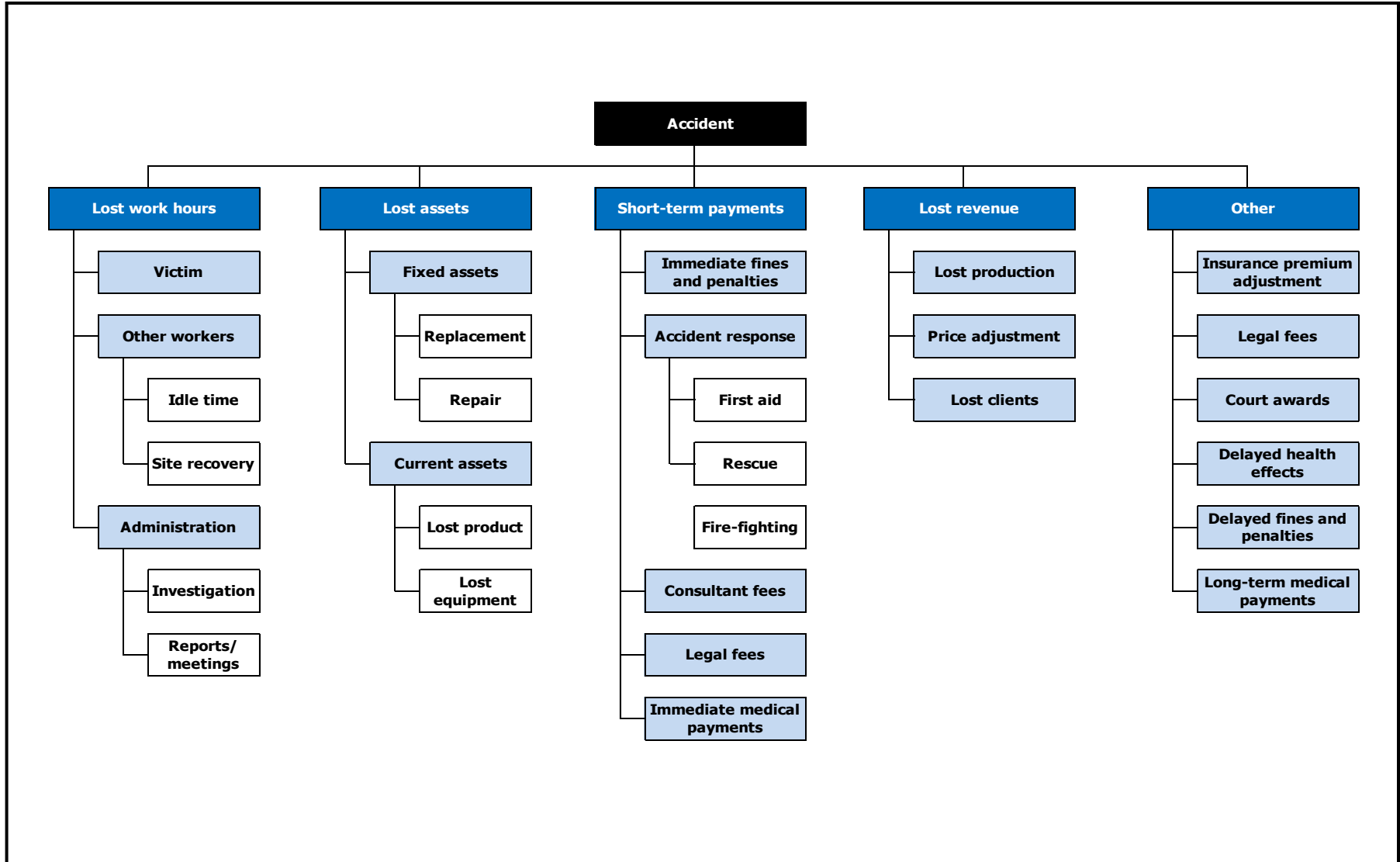


Figure 3. Sample Accident Consequence Tree

Once the Accident Consequence Tree has been developed, the consequences can then be viewed as cost items for the accident. Many of these items can then be assigned as accident cost items in the business practices of the associated corporate office, mine office, mine section, etc. These are the visible costs because these costs are readily available. The total cost of these visible items represents the accident cost traditionally assigned to the accident.

In contrast to the visible costs, the hidden costs of an accident are those items not traditionally assigned to the accident and usually require significant investigation and research effort to develop a substantially complete list of hidden cost items. The hidden costs may be found by:

- Conducting a site investigation – Investigators should return to the accident site to examine the physical data. An attempt should be made to get a complete picture of the event and the immediate outcomes as represented by the evidence.
- Conducting interviews – Investigators should speak with all worker(s), operator(s), supervisor(s), first responder(s), etc.; about the accident and the sequence of events.
- Reviewing records - Accident reports, other records of the event, and daily reports for the work area should be read and evaluated. These could include pre-shift examination and production records, supervisors' reports, timesheets, and all other source documents.

Note that it is occasionally not possible or even necessary to identify **every** hidden cost item.

It is also important to recognize that ongoing or delayed consequences will continue after the end time of the event. However, it is best to conduct an actual cost determination in real time, or as soon as possible after an event while memories of the event and evidence are fresh and while records are readily available. Nevertheless, it may also be necessary to track the consequences over time until they all can be identified and quantified.

## Cost Calculation

Once the cost items are identified and listed, the value of each listed cost item is determined. It will be necessary to go to daily reports and source documents to determine the actual cost of each item. Source documents can include:

- Cash receipts,
- Credit card receipts,
- Cash register tapes,
- Cancelled checks,
- Supplier invoices,
- Purchase orders,
- Time cards,
- Deposit slips,
- Notes for loans, and
- Payment stubs for interest.

When the actual cost of a cost item cannot be determined because records are not available, the cost can be estimated using typical values, estimated values or personal experience. If necessary, labor, equipment, and other production costs can be estimated using data provided by a cost provider such as CoalMine, a division of InfoMine [Mining Cost Service, 2008], available by subscription or using published information found in some libraries. Cost items associated with non-production efforts such as witness time and equipment rental must also be assigned a dollar value. The complete list of data collected should then be tabulated to calculate the total cost of the accident. However, it is important to realize that the total cost calculated will typically underestimate the actual cost due to the difficulty in identifying every cost item.

There are several useful websites that provide programs to estimate accident and injury costs as follows:

- WorkSafeBC - Safety Calculator at [www.worksafebc.com](http://www.worksafebc.com),
- Health and Safety Executive - The Incident Cost Calculator at [www.hse.gov.uk](http://www.hse.gov.uk),
- Mine Safety and Health Administration - Injury and Fatality Cost Calculation Worksheet at [www.msha.gov](http://www.msha.gov), and
- Occupational Safety and Health Administration - Safety and Health Management Systems eTools and Small Business Safety Pays Program at [www.osha.gov](http://www.osha.gov).

Each of these sites offers a simple computer-based interactive program and other resources for the estimation of incident costs. These programs allow for detailed costs and cost estimates to be entered under one of several suggested cost categories and the costs are then added together to yield a total cost. The forms used during this process can also be printed for use in manual calculation.

Because conducting thorough accident investigations can be time consuming, it is likely that this exercise cannot be completed for every accident that occurs. Therefore, it is recommended that a trial cost determination be conducted to reveal the nature and possible shortcomings in the company's investigation and record keeping procedures. This trial may reveal that current investigation forms need to be modified or new ones need to be developed in order to capture the data required to obtain the total cost of an accident. Additionally, trial cost determinations should be done for different types of accidents as there may be differences in the data required for each type of accident.

## **SAMPLE COST ESTIMATE REPORT**

For the following scenario the Sample Accident Consequence Tree (Figure 2) is used to find the consequences of the accident. For each consequence, the cost components are identified and recorded in an Accident Cost Worksheet. The source documents used to determine the cost of each cost component are also recorded. The following events leading up to this accident are described, as they are relevant to having a complete understanding of the scope of the consequences.

After the bench height was increased from 50 feet to 75 feet, highwall sloughing had become a continual maintenance issue. For a few days prior to the accident, truck drivers had been complaining of loose material falling from the highwall.

On January 4, the supervisor inspected the highwall from the pit floor in the fading light of dusk. The swing shift supervisor inspected the highwall with a spotlight from the pit floor. On January 5, at 1:45 AM, the highwall failed, burying the shovel and killing the 35-year-old shovel operator.

The collapse also partly buried a 777B CAT haul truck, injuring the driver. He had a broken leg, two broken ribs, cuts, abrasions, contusions, and a head injury. Six weeks following the accident, he still has trouble concentrating. The shovel was damaged beyond repair. The truck driver was extricated and transported to the hospital where he was treated for injuries. The highwall was stabilized to the point where the body of the victim could be rescued at 11:30 AM. The MSHA order was terminated at 11:45 AM on January 5. Recovery of the work site was then initiated. Efforts to reclaim the work site continued for 17 days while production was reduced to less than normal capacity.

The general information of our example is shown here.

<b>Unit/Department</b>	Main Pit
<b>Date and Time of Accident</b>	January 5 at 1:45 A.M.
<b>Event Number</b>	OCP010501
<b>Brief Description of Accident</b>	Fall of highwall with fatal and lost-time injury.
<b>Investigator</b>	First Last Names

The cost calculation of lost hours paid is shown below. The grand total of costs for hours lost for this example is more than \$61,085. These numbers will almost always be on the low side.

<b>General Information</b>					
<b>LOST HOURS</b>					
<b>Item/ Activity</b>	<b>Sub-item/ Sub-activity</b>	<b>Units/ Hours</b>	<b>Unit Costs/ Hourly Cost(\$)</b>	<b>Item Costs (\$)</b>	<b>Data Source</b>
<b>Shovel operator A-Fatality</b>	day of event	3	40	120	time records
	unused leave	120	40	4,800	time records
<b>Shovel operator B-night shift replacement</b>	cleanup	10	40	400	time records
<b>Truck operator A-Injury</b>	day of event	3	40	120	time records
	days away	40	40	1,600	time records
<b>Truck operator B-night shift</b>	day of event	3	40	120	time records
	cleanup	9	40	360	time records
	interview	1	40	40	interview
<b>Truck operator C-night shift</b>	day of event	3	40	120	time records
	cleanup	9	40	360	time records
	interview	1	40	40	interview
<b>Truck operator D-night shift replacement</b>	cleanup	10	40	400	time records
<b>Night foreman</b>	day of event	3	50	150	time record
	cleanup	9	50	450	time record
	interview	1	50	50	interview
	reports	2	50	100	interview
<b>Shift supervisor-night shift</b>	day of event	3	60	180	time record
	cleanup	7	60	420	time record
	investigation	3	60	180	interview
	reports	3	60	180	interview
<b>Shovel operator C-day shift</b>	cleanup	14	40	560	time record
<b>Truck operator E-day shift</b>	cleanup	14	40	560	time record
<b>Truck operator F-day shift</b>	cleanup	14	40	560	time record
<b>Truck operator G-day shift</b>	cleanup	14	40	560	time records

Item/ Activity	Sub-item/ Sub-activity	Units/ Hours	Unit Costs/ Hourly Cost(\$)	Item Costs (\$)	Data Source
<b>Day foreman-day shift</b>	cleanup	14	50	700	time records
<b>Shift supervisor-day shift</b>	cleanup	14	60	840	time records
<b>Vice President</b>	event	15	100	1,500	interview
<b>Administration</b>	paperwork	4	40	160	interview
<b>All pit personnel</b>	extra meetings	100	40	4,000	interview
<b>Overtime</b>		?	?	?	time records
<b>Repair of equipment</b>	repair time	?	?	?	shop records
<b>Move truck</b>				175	interview
<b>Demolish and move shovel</b>				11,300	time records
<b>Overtime</b>		?	?	?	time records
<b>Repair of equipment</b>	repair time	?	?	30,000	shop records
<b>Total Cost</b>				<b>61,085</b>	

The calculated cost estimate of lost assets is \$1,140,886. The remaining value of the shovel is estimated to be one-half the value of the new shovel since one-half the life of old shovel remained. This value is shown in parentheses as it is a negative number.

<b>General Information</b>					
<b>LOST ASSETS</b>					
Item/ Activity	Sub-item/ Sub-activity	Units/ Hours	Unit Costs/ Hourly Cost(\$)	Item Costs (\$)	Data Source
<b>Truck</b>	Parts for repair			153,186	purchasing records
<b>Shovel</b>	Purchase new			1,979,400	purchasing records
	(Remaining value of old shovel)	½ life	1,979,400	(989,700)	cost service
<b>Total Cost</b>				<b>1,140,886</b>	

The calculated cost estimate of short-term payments is \$78,300:

<b>General Information</b>					
<b>SHORT TERM PAYMENTS</b>					
<b>Item/ Activity</b>	<b>Sub-item/ Sub-activity</b>	<b>Units/ Hours</b>	<b>Unit Costs/ Hourly Cost(\$)</b>	<b>Item Costs (\$)</b>	<b>Data Source</b>
<b>Accident response</b>	first-aid materials	1	500	500	purchasing records
	transport vehicle	10 mi.	100	1,000	purchasing records
<b>Replacement worker</b>				5,000	purchasing records
<b>Insurance deductibles</b>				25,000	insurance policy
<b>Consultant fees</b>				3,000	purchasing records
<b>Demurrage</b>				1,800	purchasing records
<b>Fines and penalties</b>				40,000	accounting
<b>Legal fees</b>				2,000	purchasing records
<b>Total Cost</b>				<b>78,300</b>	

The calculated estimate of lost revenue is \$4,158,000:

<b>General Information</b>					
<b>LOST REVENUE</b>					
<b>Item/ Activity</b>	<b>Sub-item/ Sub-activity</b>	<b>Units/ Hours</b>	<b>Unit Costs/ Hourly Cost(\$)</b>	<b>Item Costs (\$)</b>	<b>Data Source</b>
<b>Lost production</b>	Lost while pit down	23.5 days x 7,200 tpd	15/ton	2,538,000	production records
	Reduced while shovel replaced	30 days x 3,600 tpd	15/ton	540,000	production records
<b>Total Cost</b>				<b>4,158,000</b>	

The calculated estimate of other costs is \$22,000. The costs in this category may be underestimated because of the time required for them to occur. For example, if an insurance premium adjustment occurs as a result of this accident, it may take one, two, or three years, depending upon the loss history of the company. Court awards may not show up for years. Consequently, these costs would need to be estimates.



General Information					
OTHER COSTS					
Item/ Activity	Sub-item/ Sub-activity	Units/ Hours	Unit Costs/ Hourly Cost(\$)	Item Costs (\$)	Data Source
Insurance premium adjustment				20,000	insurance agent
Court awards				?	
Interest on delayed reimbursement	Workers' compensation payments			2,000	accounting records
<b>Total Cost</b>				<b>22,000</b>	

When all of the costs are determined, an accident cost worksheet summary should then be developed. It should include general information, cost class, total cost for each class, and the grand total accident cost. For the example presented, the grand total cost estimate is \$5,460,271:

General Information	
Cost Class	Class Total Cost(\$)
Lost Hours	61,085
Short-term Payments	78,300
Lost Revenue	4,158,000
Lost Assets	1,140,886
Other	22,000
<b>Grand Total Cost</b>	<b>5,460,271</b>

This estimate would, again, be on the low side. There is a possibility that a few of these costs would be covered by insurance. This is an extreme example in which the severity was very high. The very same incident may have been of very low severity, such as a near miss, in which no one was injured or no equipment was damaged. Even so, there would still be significant costs incurred in stabilizing and reclaiming the work site.

## **SUMMARY**

The total cost of an accident can be determined using logical investigation techniques in which all visible and hidden costs of the accident are fully identified and quantified. By conducting an accident total cost determination, the impact of accidents on the company's profit becomes more apparent. Hence, with a clearer focus on the net return on safety and health investments, management can make more informed decisions regarding accident prevention expenditures.

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## **APPENDIX**

The following scenarios are based on site visits, interviews, and record reviews. Using the universal cost classes construct an Accident Consequence Tree for each scenario to the extent that the information given allows. Then using the consequences discovered by this process, and using as a guide the cost item categories from Table 1, develop an Accident Cost Worksheet for each situation. The format of these exercises can be any format that works for the situation. Units are derived from the narrative. Typical values are derived from various sources such as those suggested in the bibliography, the internet or from personal experience. This process rarely captures every cost item and total values will be approximate.

### **Exercise 1**

#### **Event Description**

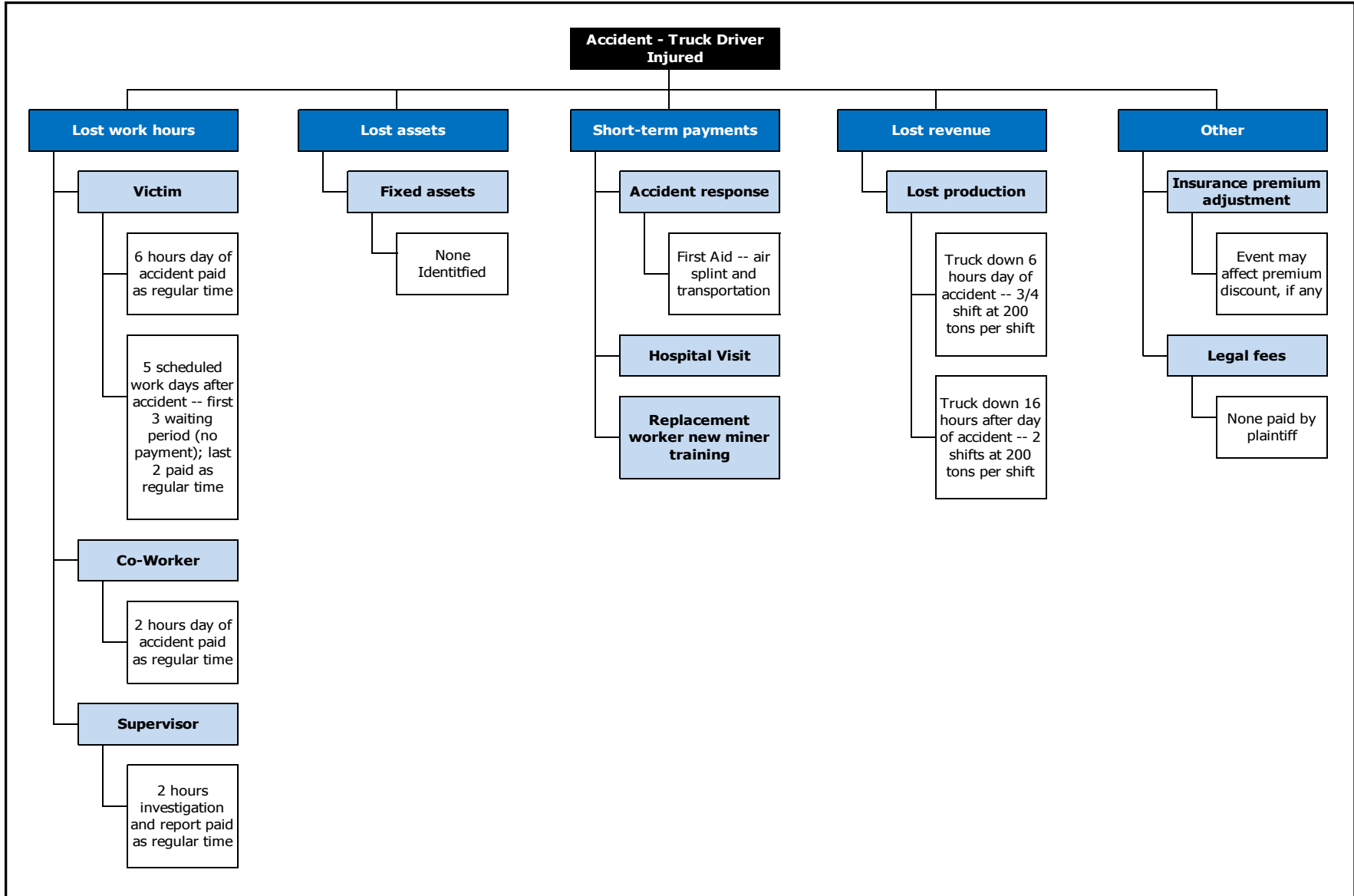
At a gravel pit in Utah at 09:30 of an 08:00 to 16:00 shift on Thursday, October 30, 2008 a 50 year-old truck driver was injured. Dismounting from his truck, he jumped to the ground from the second step and fractured his ankle upon landing. An air splint was applied and he was taken 20 miles to the hospital by a co-worker. The co-worker returned to work at 11:30. The injured returned to work after missing 5 scheduled workdays after the shift he was injured. He returned to work with restrictions and was terminated immediately for pattern of safety violations. The involved truck was placed back in service on Tuesday, November 4, 2008 after a new driver received new miner training. The supervisor took 2 hours investigating and reporting the accident.

The mine produces 600 tons per day working one 16-hour shift per day, five days per week and using three trucks to haul to the hopper.

A wrongful termination claim against the company was dismissed after six months of litigating

The company insurance policy deductible is \$2,000 per occurrence. It was the first lost-time accident in three years at this mine.

# Accident Consequence Tree



## Cost Calculation

Accident-Truck driver injured						
Class	Item	Sub-item	Units	Unit Cost	Total Cost	Source
<b>Lost time</b>	truck driver	day of injury	6 hours	40	\$240	wage table
		after day of injury	16 hours	40	\$640	wage table
	co-worker	day of injury	2 hours	40	\$80	wage table
	supervisor	investigation/report	2 hours	50	\$100	wage table
	clerical	paperwork	1 hour	20	\$20	salary table
<b>Lost assets</b>	none identified	-	-	-	-	narrative
<b>Short-term payments</b>	first aid supplies	air splint	1 each	\$20	\$20	supply catalogue
	medical payments	doctor visit/treatment	1 each	\$200	\$200	standard charts
	transportation	company truck	40 miles	\$1	\$40	edmunds.com
	replacement worker	training	1 each	\$100	\$100	training course catalogue
<b>Lost revenue</b>	lost production	one truck-two days	400 tons	\$8	\$3,200	USGS
<b>Other costs</b>	legal fees	paid by plaintiff	--	-	-	-
	insurance premium	may increase next year	-	-	-	laborcommission.utah.gov
<b>Total cost</b>					<b>\$4,640</b>	

All costs paid by operator because insurance deductible was not reached.

## **Exercise 2**

### **Event Description**

At an underground coal mine in Colorado at 22:00 of a 16:00 to 24:00 shift on Monday, February 25, 2002, a 40 year-old roof-bolting machine operator received permanent injury, losing the use of his left arm. The operator was working and a large coal and rock rib struck him crushing his left arm. Measures to rescue the victim were delayed due to coal and rock from the rib continuing to fall. After about one hour the victim was extricated by the five-man rescue team and transported to the surface by unit truck. At the surface, a County Hospital ambulance took over the care of the victim transporting him 15 miles to the hospital.

The section was under a 103(k) order for 8 hours and it took two shifts to clear and recover the site. A replacement driller required 4 hours of training on a new drill. The amount of coal made inaccessible by roof conditions was 900 tons. The mine was cited for violations of 75.220(a)(1), S&S, High Negligence and 75.362, S&S, High Negligence, total penalties paid were \$3,205.

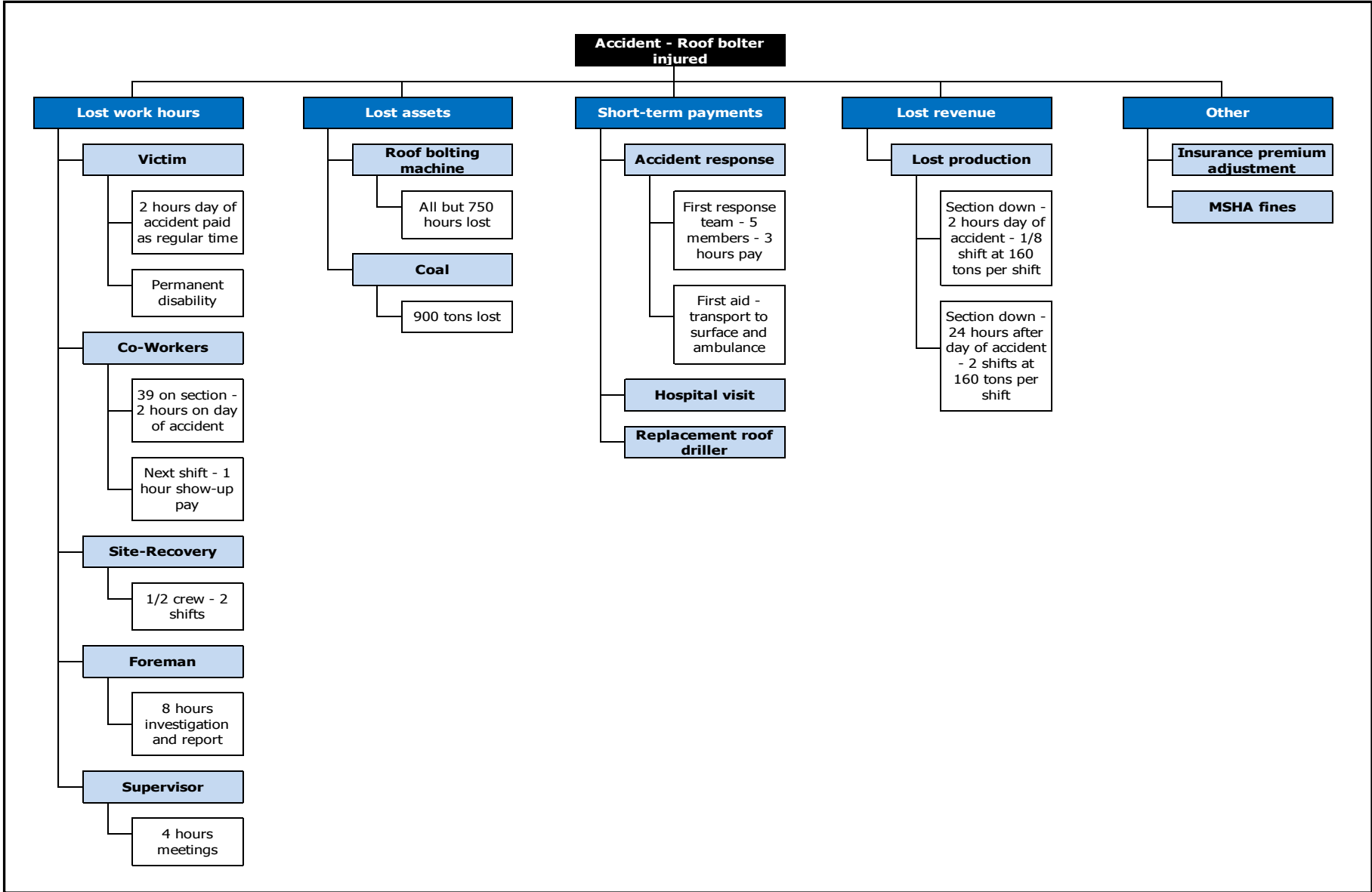
The drill was a J.H. Fletcher II, Model No. RRII15, dual boom, single bar ATRS. It had 750 hours use and was a total loss.

The mining operation produces two shifts a day and maintains on the third shift. Total employment is 195 (175 work underground, 40 on the section). Production is 960 tons per day from three mechanized mining units. Section haulage is by diesel ram cars and conveyor belts that transport to the surface.

The company insurance policy is a \$25,000 deductible. This is the seventh serious accident at this mine this year and the company was put into and assigned risk pool raising premiums by \$13,000 a year.



# Accident Consequence Tree



## Cost Calculation

<b>Accident-Roof bolter injured</b>						
<b>Class</b>	<b>Item</b>	<b>Sub-item</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Total Cost</b>	<b>Source</b>
<b>Lost Time</b>	victim	2 hours day of accident-paid as regular time	2 hours	\$50	\$100	wage table
		permanent disability	remainder of deductible	\$7,200	\$7,280	insurance policy
	co-workers	39 on section-2 hours on day of accident	78 hours	\$50	\$3,900	wage table
	co-workers next shift-1 hour show-up pay	40 on section-1 hour each	40 hours	\$50	\$2,000	wage table
	site recovery	1/2 crew-two shifts	320 hours	\$50	\$16,000	wage table
	foreman	operating expenses day of accident	16 hours	\$200	\$3,200	Infomine
			2 hours	\$60	\$120	salary table
	superintendent	investigation and report meetings	8 hours	\$60	\$120	salary table
4 hours			\$80	\$320	salary table	
<b>Lost Assets</b>	roof-bolting machine	all but 750 hours lost	17,000 hour life	\$400,000	\$382,353	Infomine
	coal made inaccessible	-	900 tons	\$35	\$31,500	USGS
<b>Short-term payments</b>	accident response	first response team 5 members-3 hours at regular pay	15 hours	\$50	\$750	wage table
	transportation	ambulance	one call	\$300	\$300	standard charts
			15 miles	\$8	\$120	standard charts
	medical payments	hospital visit	1 each	\$400	\$400	standard charts
	replacement worker	training	4 hours	\$50	\$200	wage table
	insurance deductible				\$25,000	insurance policy
<b>Lost revenue</b>	lost production	section down day of accident 2 hours	4 tons	\$30	\$1,200	USGS
		section down 3 shifts after accident-2 production shifts	320 tons	\$30	\$9,600	USGS
<b>Other</b>	MSHA fines				\$3,205	CFR 30
	premium adjustment	first year			\$13,000	insurance underwriter
<b>Total Cost</b>					<b>\$500,668</b>	