ANALYSIS OF MINE ACCIDENTS AND FINANCIAL CONSEQUENCES TO GLİ MINES

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ABSTRACT

ANALYSIS OF MINE ACCIDENTS AND FINANCIAL CONSEQUENCES TO GLİ MINES

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The expenditures resulting from work accidents is increasing every year. Among the other work accidents, mine accidents result important loss of time, money and lives. From the point of view of mine accidents, studies about cost of mine accidents need some contributions. In this thesis, cost of mine accidents to worker, employer, and total economy of country will be analysed in the light of data from Ministry of Labour, Social Security and Social Insurance Institution, and Türkiye Coal Enterprises. General Analysis is carried out within all industrial sectors, Mining sector, and Coal Mining sector. Detailed analysis is carried out within Western Lignite Company (GLİ).

Occupational accidents have vital importance for the mines from legal, human and economic aspects. The goal of every mine should be to minimize occupational accidents. The top management of every mine should prove their commitments to the occupational health and safety policy to carry out this goal by means of preparing and implementing an accident preventing program.

Keywords: Mine accidents, accident investigation, mine accident cost, mine accident statistics, Mine fatalities, and lost days, GLİ, GLİ 2006 mine accidents.

ÖZ

MADEN KAZALARININ ANALİZİ VE KAZALARIN GARP LİNYİTLERİ İŞLETMESİNE MALİ ETKİLERİ

Özkan, Gökay
Y. Lisans, Maden Mühendisliği Bölümü
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İş kazalarının ülke ekonomisine getirdiği yük her geçen yıl artmaktadır. Tüm iş kazaları içerisinde madencilik faaliyetleri sırasında meydana gelen iş kazaları zaman, para ve can kaybı açısından önemli bir yer tutmaktadır. Maden kazaları açısından bakıldığında ülkemizde bu kazaların maliyetleri konusundaki çalışmaların katkıya muhtaç olduğu görülecektir. Bu tezde, Çalışma ve Sosyal Güvenlik Bakanlığı, Sosyal Sigortalar Kurumu ve Türkiye Taş Kömürü Kurumundan elde edilecek veriler ışığında Türkiye'deki iş kazalarının, maden kazalarının, kömür madenciliğindeki kazaların analizleri genel olarak ve Garp Linyitleri İşletmesindeki iş kazalarının analizi detaylı olarak, 2006 yılına ait verilerle analiz edilecek ve bu kazaların çalışana, işverene ve ülke ekonomisine yüklediği maliyetin analizi yapılacaktır.

İş kazaları madencilik açısından gerek yasal, gerek insani ve ekonomik açılardan büyük bir öneme sahiptir. Maden işletmelerinin amacı, faaliyetleri sırasında iş kazalarını en aza indirerek, kaza maliyetlerini ve dolayısıyla genel işletme maliyetlerini düşürmek olmalıdır. Kuruluş üst yönetimleri, iş sağlığı ve güvenliği politikalarını oluşturup bu politikalardaki hedeflere, kaza önleme programlarını uygulayarak ulaşmalıdırlar.

Anahtar Kelimeler: Maden Kazaları, Kaza Analizi, Maden Kazalarının Maliyeti, Maden Kazaları İstatistikleri, GLİ, GLİ 2006 Maden Kazaları.

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To my family, I would like to express my great pleasure for their support during every stage of this thesis.

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CHAPTER 1

INTRODUCTION

1.1 Health at work

According to International Labour Office statistics, 120 million occupational accidents occur annually at workplaces worldwide. Of these, 210,000 are fatal accidents. Every day, more than 500 men or women do not come home because they were killed by accidents at work (ILO, 2002). These are dramatic numbers which draw fairly little public attention. Considering the fact that accidents take a considerable economic toll from nations, companies and individuals, accidents do not get much publicity.

Although effective occupational health and safety programs and many structural changes have improved the conditions of work in some sectors, several hazardous agents and factors such as physical, chemical, biological as well as psychosocial stress in addition to occupational accidents still threaten the health of workers in all countries continuing to cause occupational and work-related diseases and injuries throughout the world. In some economic sectors and in some countries occupational health indicators show even worse trends than in the past. Although the transfer of healthy and safe technologies has had a positive impact on development, the transfer of hazardous technologies, substances and materials to developing countries, which have insufficient capacity to deal with such problems, constitute a threat both to the health of workers and the environment.

The level of occupational health and safety, the socioeconomic development of the country and the quality of life and well-being of working people are closely linked with each other. This suggests that intellectual and economic inputs in occupational health are not a burden but have a positive and productive impact on the company and national economy.

Thus occupational health is an important factor for sustainable socioeconomic development that enables workers to enjoy a healthy and productive life both throughout their active working years and beyond.

1.2 Occupational Health and Safety in Mining

The mining industry is a vital economic sector for many countries and comprises the utilization of coal, metal, and non-metal minerals. The use of minerals by nations worldwide is extensive and includes electrical generation, production of cement, steel, agricultural lime, commercial and residential building products, asphalt, and medicines, as well as countless household, electronic, and other manufactured products.

Historically, mining has been one of the most hazardous work environments in many countries around the world. In addition, due to their severity and frequency mining injuries, illnesses, and fatalities are among the costliest, e.g., Leigh et al. (2004) report that U.S. lignite and bituminous coal mining rank second in the nation for the average cost per worker for fatal and all nonfatal injuries and illnesses. However, over the last century the numbers of U.S. mining fatalities and the fatality incidence rates as well as injuries have decreased (Ramani and Mutmansky, 1999). Figure. 1.1 shows the total number of injuries for coal, metal and non-metal mining that has occurred from 1978 through 2005, while Figure. 1.2 shows the total number of fatalities for the same period. The data for coal mines indicate a total of 311,965 injuries for the 28-year period from 1978 through 2005 (11,141 per year), and 183,940 injuries in the metal and non-metal sector (6569 per year). The total number of fatalities for the same period was 1835 in coal mining (65 per year) and 1626 for metal and non-metal mining (58 per year). The historical record of injuries continues to show a significant decline and the number of fatalities has dropped from 267 in 1979 to 55 in 2004, the lowest number of mining fatalities ever recorded (MSHA, 2006).

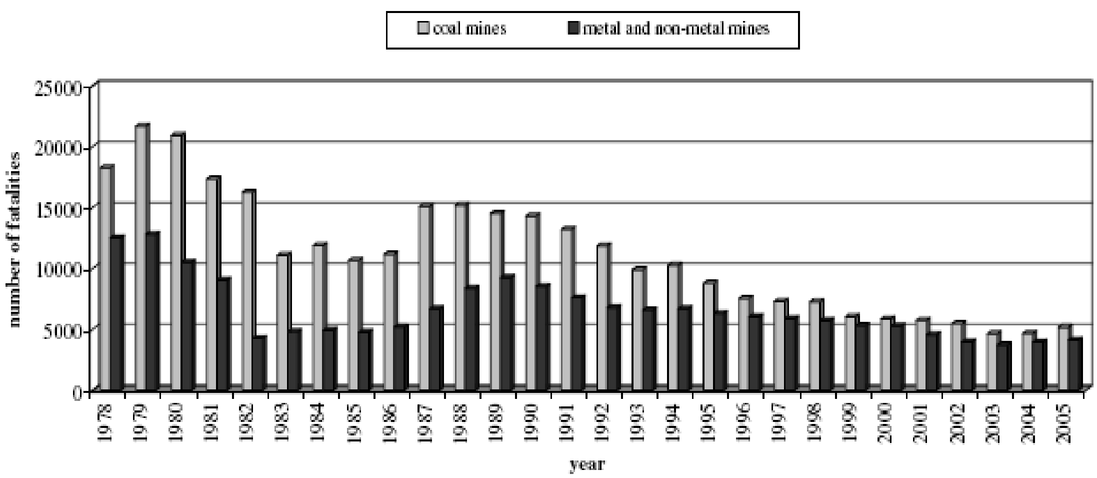

Figure 1.1 The total number of injuries for coal, metal and non-metal mining 1978-2005 in U.S.A. (MSHA, 2006).

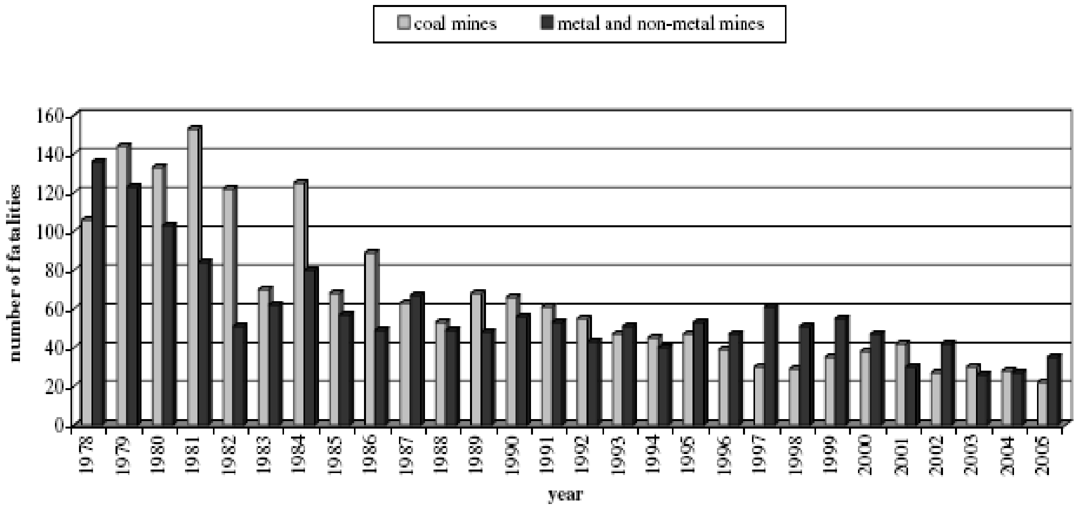

Figure 1.2 The total number of fatalities for coal, metal and non-metal mining 1978-2005 in U.S.A. (MSHA, 2006).

Despite the record of progress that has been achieved in reducing mining fatalities and injuries, both the number and severity of the mining accidents are still unacceptable. Future mine health and safety progress requires the systematic planning of appropriate safety programs and measures. The safety management decisions which must be made to select and prioritize problem areas and safety system weaknesses must be based on the recognition of hazards encountered in each activity of the mining process.

1.3 Importance of Costs of Workplace Accidents

In modern industries including coal mining, cost plays an important role. Safety in relation to cost stands in a specific position because for every industrial operation some element of safety is essential. If this is lacking, operations do not remain under control and schedules and unit costs can not be counted upon. Breakdown involving costs and sometimes substantial costs become frequent. Compensation amounts rise; supply of skilled people with right attitudes and motivation becomes difficult; labor relations become strained and efficiency and productivity stand impaired.

To the employer, an accident cost can be serious. Loss of a key worker for a long period or even permanently, damage to plant, waste of materials, or breach of delivery commitments, interruptions to work, disorganization and other events that flow from accidents may decrease efficiency and add substantially to production costs.

The European Agency for Safety and Health at Work has estimated that 4.6 million occupational accidents happen every year in the EU resulting in 146 million lost working hours (EU OSHA, 2001). This means that approximately 2.6–3.8% of the collective EU gross national production (GNP) is lost every year. In an earlier survey of workplace injury costs in the US, Miller and Galbraith, 1995 estimated that workplace injury costs in the US amount to US$ 140 billion annually. These studies include costs such as medical and emergency costs, lost wages, administrative costs, legal costs, workplace disruption, and loss of quality of life. Workplace disruption costs account for US$ 10 billion and loss of quality of life is estimated to US$ 62 billion.

CHAPTER 2

MINE ACCIDENT ANALYSIS

An occupational accident can be described as follows:

The final event is an undesirable, unexpected and unplanned event sequence that interrupts an activity, and directly or indirectly results in immediate or delayed injury or illness to an employee, and may or may not result in property damage or loss in production.

On the other hand, according to Turkish Social Insurance Act 506,"A work accident means an accident occurring in any one of the circumstances or situations indicated below which causes immediately or subsequently a physical or mental invalidity to an insured person:

a. When the insured person is in the workplace;

b. In connection with the work carried on by the employer,

c. When the insured person has been sent by the employer to perform duties at another place;

d. During the period allocated for the nursing of the child of the insured woman;

e. While insured persons are carried as a group on a vehicle supplied by the employer, to and from the place where the work is being done.

2.1 Types of Mine Accidents

The accident type is important in accident prevention program. The recurrence of accidents of a particular type indicates areas needing special emphasis. Accident types are given below (Report of U.S Department of the Interior, Mining Enforcement and Safety Administration, 1977):

i) Electrical: Accidents in which the electric current is most directly responsible for the resulting accident.

ii) Entrapment: Accidents involving entrapment of persons.

iii) Exploding Vessels Under Pressure: Accidents involved with bursting or rupturing of air hoses, air tanks, hydraulic lines, hydraulic hoses, standpipes, etc., due to internal pressure.

iv) Explosives and Breaking Agents: Accidents involving the detonation of manufactured explosives; includes Airdox or Cardox, that can cause flying debris, concussive force, or fumes.

v) Falling, Rolling, or Sliding Rock or Material of Any Kind: Accidents caused directly by falling material other than materials from the roof or face. If material was set in motion by machinery, by haulage, by hand tools, or while being handled or disturbed, etc., the force that set the material in motion determines the classification. For example, where a rock was pushed over a highwall by a bulldozer and the rock hit another rock that hit and injure a worker—the accident is classified as machinery; machinery (a bulldozer) most directly caused the resulting accident.

vi) Fall of Face, Rib, Pillar, Side, or Highwall (from in place): Accidents in this classification include falls of material while barring down or placing props; also, pressure bumps and bursts. Not included are accidents in which the motion of machinery or haulage equipment caused the fall either directly or by knocking out support.

vii) Fall of Roof, Back, or Brow (from in place): Underground only - accidents that include falls while barring down or placing props; also, pressure bumps and bursts. Not included are accidents in which the motion of machinery or haulage equipment caused the fall either directly or by knocking out support.

viii) Fire: Accidents related to uncontrolled burning of material or mineral in the mine environment. Not included are fires initiated by electricity or by explosion of gas or dust.

ix) Handling Material: Accidents related to handling packaged or loose material while lifting, pulling, pushing, or shoveling.

x) Hand Tools: Accidents related to non-powered tools.

xi) Non-powered Haulage: Accidents related to the motion of non-powered haulage equipment. Included are accidents involving wheelbarrows, manually pushed mine cars, timber trucks, etc.

xii) Powered Haulage: Accidents related to the motion of powered haulage equipment. They include accidents involving conveyors, front-end loaders, forklifts, shuttle cars, load-haul dump units, locomotives, railroad cars, haulage trucks, pick-ups, automobiles, and personnel carriers.

xiii) Hoisting: Accidents involving cages, skips, ore buckets, and elevators. The accident results from the action, motion, or failure of the hoisting equipment or mechanism. Included are equipment such as cranes and derricks only when used in shaft sinking; also, suspended work platforms in shafts. Equipments such as chain hoists, come-alongs, and winches are not included in this type.

xiv) Ignition or Explosion of Gas or Dust: Accidents resulting as a consequence of the ignition or explosion of gas or dust.

xv) Impoundment: Accidents caused by an unstable condition or failure of an impoundment, refuse pile, or culm bank requiring emergency preventative action or evacuation of an area.

xvi) Inundation: Accidents caused by inundation of a surface or underground mine by a liquid (or semisolid) or a gas.

xvii) Machinery: Accidents related to the motion of machinery. All electric and air-powered tools and mining machinery such as drills, tuggers, winches, slushers, draglines, power shovels, loaders, and compressors are included in this type.

xviii) Slip or Fall of Person (from an elevation or on the same level): Accidents include slips or falls while getting on or off machinery and haulage equipment that is not moving, and slips or falls while servicing or repairing equipment or machinery.

xix) Stepping or Kneeling on Object: Accidents are classified in this category only where the object stepped or kneeled on contributed most directly to the accident.

xx) Striking or Bumping: This classification is restricted to those accidents in which an individual, while moving about, strikes or bumps an object, but is not handling material, using hand tools, or operating equipment.

xxi) Other: Accidents not elsewhere classified.

2.2 Cause of Accident

Cause is the reason for the accident. The unplanned or unwanted release of excessive amounts of energy cause most accidents. Energy is mechanical, electrical, chemical, thermal, or ionizing addition. Another cause may be hazardous materials such as carbon monoxide, carbon dioxide, hydrogen sulfide, methane and water. With few exceptions, these releases are in turn caused by unsafe acts and unsafe conditions. An unsafe act or an unsafe condition may trigger the release of large amounts of energy or of hazardous materials. This in turn may cause the accident.

Unsafe acts and conditions are the basic causes of accidents. They are only symptoms of failure. The basic causes are poor management policies and decisions, and personal and environmental factors. Fortunately, most mine operators now realize that safety must be a necessary part of the total operating system. These operators take the responsibility to prepare a written safety policy guide and to install safety awareness in their employees. Selection, training, employee placement, and equipment and supply purchasing are important to a successful accident prevention program. Accident prevention programs involve the maintenance of a safe and healthful environment and the setting up of adequate operating and emergency procedures.

2.2.1 Direct Causes

A detailed analysis of an accident must consider the direct causes (released energy and/or hazardous material). Accident investigators look at the direct causes because equipment, materials and facilities can be redesigned to prevent recurrences. The direct causes also help train miners to be aware of hazardous situations, and to provide personal protection to prevent injury. An experienced miner can usually identify hazardous energy sources (electric cables; poor roof; highwalls; machinery) and take the necessary precautions.

2.2.2 Indirect Causes

Unsafe acts and unsafe conditions do not by themselves cause accidents. They are symptoms of poor management policy, inadequate controls, lack of knowledge, improper assessment of existing hazards, or other personal factors (Accident Prevention Safety Manual No: 4.). A few of the more common unsafe acts and conditions found in mining activities include:

Unsafe Acts:

- Operating equipment at improper speeds
- Operating equipment without authority
- Using equipment improperly
- Using defective equipment
- Making safety devices inoperable
- Failure to warn coworkers or to secure equipment
- Failure to use personal protective equipment
- Improper loading or placement of equipment or supplies
- Taking an improper working position
- Improper lifting
- Servicing equipment in motion
- Horseplay

- Using alcoholic beverages
- Using drugs

Unsafe Conditions:

- Inadequate supports or guards
- Defective tools, equipment or supplies
- Congestion of work place
- Inadequate warning systems
- Fire and explosion hazards
- Poor housekeeping
- Hazardous atmospheric conditions (gases, dust, fumes, vapors)
- Excessive noise
- Poor illumination
- Poor ventilation
- Radiation exposure

2.2.3. Basic Causes

Many accident prevention activities involve only the identification and correction of unsafe acts and conditions. While this is an important function, identifying basic causes corrects long-range problems. These can be grouped into three related categories:

- Management Safety Policy and Decisions
- Personal Factors
- Environmental Factors

The first group, management safety policy and decisions, includes such items as management's intent (relative to safety). Also included are production, safety goals and staffing procedures. Other areas are the use of records and assignment of responsibility and authority. Included are employee selection, training, placement, direction, supervision, communications procedures, inspection procedures, equipment, supplies, facilities design, purchase and maintenance, standard and emergency job procedures, and housekeeping.

The second group, personal factors, includes motivation, ability, knowledge, training and safety awareness. Also included are assignment, performance, physical and mental state, reaction time, and personal care. The third group, environmental factors, includes temperature, pressure, humidity, dust, gases, vapors, air currents, noise, illumination, and nature of surroundings.

Nature of surroundings includes slippery surfaces, obstructions, inadequate supports, and hazardous objects. These three groups are interrelated. A change of one factor (for example, employee selection) affects others (such as training, placement, equipment design, etc.).

2.3 Accident Prevention

Accidents are avoidable when everyone works together to prevent them. Some of the procedures involve the identification and elimination of unsafe acts and unsafe conditions. These procedures are only one of a series of steps to develop a worthwhile accident prevention program. Most organizations begin by developing a safety policy and carefully selecting and training workers. Supervisors and managers may periodically review all procedures, institute inspection procedures, and correct deficiencies. However, accident prevention should operate on three levels. The first level is an effort to learn the basic causes of each accident. One way is by conducting special surveys of the hazards that exist. This is done by analysis of the procedures used to conduct each job. Job safety analysis and accident investigation are examples of such procedures. These surveys help establish a useful safety policy. They also create safety awareness, and determine the personal and environmental factors that require attention.

Indirect causes, unsafe acts and unsafe conditions are eliminated at the second level. This can be done by first keeping accurate records of all incidents and accidents. To determine necessary corrections, periodic evaluation of these records is necessary. Again, this must be a joint effort of all involved: workers, supervisors, managers, and top executives. Develop safe procedures, suitable education and training programs, and improve the work environment and procedures to motivate all employees to work safely. Design proper equipment and facilities. Conduct periodic inspections, and maintain safe equipment and facilities.

At the third level, direct causes, are dealt with by giving special attention to the protection of people and property. Where possible, reduce the quantities of available energy or hazardous material. When all else fails, protect each worker with suitable equipment and structures (personal protective equipment; cabs; canopies; barricades). In addition, make arrangements to furnish first aid, medical attention, and transportation to a medical facility when an accident happens.

2.4 Importance of Mine Accident Statistics

Statistics of accidents have proved to be essential for planning accident prevention activities and for assessing their effectiveness. It is from statistics that all the technicians, researchers and safety officers learn how many accidents occur, what kind of accidents they are, how serious they are, what classes of workers incur them, what methods, machines and other equipment are involved in them, what sort of behaviors are associated with them, and at what times and places they occur most frequently. Statistics provide a bird's-eye view, as it were, of the situation, and without them it would be practically impossible to estimate needs or judge results.

In order that accurate statistics be complied it is, of course, necessary that all accidents be reported with the person, or department responsible for compiling the statistics. Such reports must provide the kind of information needed for the particular statistical studies in view and in a form information refers only to the total number of accidents must be studied in relation to the number of hours of exposure to the risk. For the compilation of severity rates the amount of time lost will be required as well. For statistics showing the distribution of accidents by cause, type of accident, nature of injury, equipment involved, or age of the employee, still more information required, and the more complicated the report form required. It is not often possible to fill in a report form until the accident is thoroughly investigated which will have to be done in any case if the causes of the accident are to be correctly indicated.

Statistics have also been compiled to give an idea of how accidents are distributed over the different hours of a working day and how many accidents happen on each day of the week. Such information is very interesting that the general environment remains unchanged and the human factor is much more likely to be the cause of variations.

The question whether more experienced workers have more or fewer accidents than less experienced ones can be discussed with the aid of statistics indicating how accidents are distributed among workers with different lengths of service, or statistics giving information on accidents in which skilled and unskilled workers working under similar circumstances are involved.

Statistics of this kind give interesting information on a different number of factors. However it is difficult to interpret this information accurately, since it is not immediately apparent whether, for instance, the differences shown can be attributed solely to the factors mentioned or whether other factors are also involved. A certain number of reasonably definite conclusions can be drawn from the statistics shown. As a result statistics suggest that something should be done to improve the matters.

The quantitative analysis of accident and injury data is done for measuring the safety performance and identifying safety problems. Since the purpose of safety management is to reduce the number of accidents and injuries and to control hazards, the total number of accidents would seem to be the most useful index for measuring the effects of a safety program. However the major limitation of this index is that the exposed man-hour is not considered. To avoid this problem, normalized indices such as the accident frequency rate is defined as the number of injuries for each million man-hours of exposure (Tenth International Conference on Labor Statisticians, ILO, 1962). This is expressed by the following formula, in which AFR represents the accident frequency rate:

$$AFR = (\text{Number of Accidents} / \text{Total Man-Hours of Exposure}) \times 1{,}000{,}000 \qquad \text{Eq 1}$$

So far only the number of accidents has been considered, and this is not a very exact measure of the effects of the accidents. To obtain a better idea of the situation, the severity rate must also be calculated. The severity rate is defined as the total number of days lost per thousand man-hours of exposure. This rate is expressed by the following formula, in which ASR represents the accident severity rate:

$$ASR = (\text{Number of Days Lost} / \text{Total Man-Hours of Exposure}) \times 1{,}000 \qquad \text{Eq 2}$$

The calculation of severity rates is more difficult when an accident gives rise to permanent disability or death. In Türkiye for each fatal case, the time lost in days is increased by a time charge of 7,500 days.

As might be expected, such a serious accident has a considerable effect on the severity rate, but does not greatly affect the frequency rate.

Accident frequency and severity rates give valuable information on the safety situation of the mines and/or any other related industries. These rates can be also used in the mining industry as comparative stand arts for safety measurements either between the years in the same mine, or between mines in the same company in the same period and between the company and the industry average in the same period (Bhattacherjee and Ramani 1991).

In the recent past, analysis of mine accident / injury data to understand safety problems of the mining industry in USA has been performed by several researchers such as Sinha et al. (1974), and Pfleider and Krug (1973). The early researches were mostly directed towards quantifying accident data, very often mine fatalities according to frequency and severity rate and identifying curative approaches through such avenues as machine modifications, job redesign, and miner training. Further some of these studies have examined the relationship between injury rates and experience, mining method, productivity and roof conditions. Later research made by Cooley and Hill (1981) Sanders and Peay (1988) however, have directed attention to the use of system safety analysis and human factor approaches.

The collection, analysis and use of accident / injury experience data for identifying safety problems must be a continuing endeavor. The importance of the quantification of accident data based on statistical indices such as frequency rate, severity rate, to focus attention on safety cannot be questioned.

CHAPTER 3

THE ECONOMICS OF WORKPLACE ACCIDENTS

Occupational disease and injury are part of the human and social costs of production. These are primarily the suffering and possibly life-long disadvantages of affected workers and their families. Furthermore, a large number of studies have demonstrated the high economic cost of accidents borne by enterprises and governments. Direct costs for enterprises, such as material damage and down-time, and financial losses through experience-related insurance premia and a share of the medical expenses, are obvious. In addition, hidden costs, such as overtime work made necessary by accidents, retraining expenses and intangible factors such as loss of company prestige and worsening industrial relations, may have a substantial impact on the quality and profitability of production. Some authors estimate these hidden costs for enterprises at several times the direct costs (Andreoni (1986); Heinrich, Petersen and Roos (1980); Celebrezze (1987))

Taking into account three overall cost factors - consequential expenditure due to injury as well as to material damage; production losses; and administrative costs - total economic costs of work accidents for society have been estimated as ranging from around one percent of gross domestic product in the United Kingdom and the United States to a little above three percent in France, without even accounting for expenditure on prevention (Andreoni 1986). Using a different measure, studies by the International Labour Office have shown a ratio of accident insurance expenditure to total social security expenditures of between three and seven percent (Andreoni 1986). The costs of accidents may be distinguished from costs of accident prevention. These include the work of staff administering and enforcing safety legislation, the financial cost of expenditure on safer equipment, and possible losses of productivity that may arise through constraints on working methods introduced for safety reasons.

According to Ary (1989), the average cost of a lost time accident varies from $7,000 to $13,000 and that of a fatality from $800,000 to $1,200,000 in US.A. Also U.S Occupational Safety and Health Administration (OSHA), uses $ 910,000 for each number of deaths, $28,000 for each number of lost workday cases, and $7,000 for each number of reportable cases without lost work days while calculating the cost of an accident. On the other hand, according to United States Department of Interior Bureau of Mines Report (1992) in 1991, the total costs of the accidents for underground and surface coal mining in U.S.A. are $156,546,961.

Broadly speaking, there are three general purposes that economics can serve for OSH. First, identifying and measuring the economic costs of occupational injury and disease can motivate the public to take these problems more seriously. This is true at all levels; from the enterprise that may be only dimly aware of the toll that worker ill-health takes on its performance to national governments that may not realize the impact of OSH problems on economic growth and development. Second, understanding the connections between the way firms and markets function and types of OSH problems that arise is crucial for the success of public policy. As the pace of economic change picks up throughout the world, these questions need to be addressed on a continuing basis. Finally, as important as the protection of worker health and well-being is, it is not the only objective of modern society. Economic analysis can help show when safeguarding working conditions is complementary to other social goals, and it can illuminate the tradeoffs when it is not. Clearly, to the extent that there are trade offs, they do not go away if they are not measured.

For all of these goals, a central concept is that of costs. On the one side, we have the costs of improving the conditions of work, in order to reduce the incidence of injury and disease. On the other, there are the costs of not doing these things. But the concept of costs is not simple; there are many kinds of costs, and the distinctions are important for the analysis of OSH. These will be the ways that costs can be distinguished:

Economic vs Non-economic Costs: Without going deeply into the details of economic theory, it is enough to say that economic costs are those which can be expressed in monetary units. They include the costs paid or expected to be paid by individuals and organizations acting within the economy, as well as the monetary values implicit in activities undertaken and foregone. Non-economic costs are no less real, but for one reason or another cannot be captured in monetary terms. In the case of injury and disease, the non-economic costs are above all the subjective costs of pain, fear, and loss suffered by the victims, their families, and their immediate communities. For shorthand, they will be referred as the human costs of ill-health or premature death. In addition, it should be recognized that the loss of life and health is often opposed for reasons that are not reducible to their cost in either the economic or non-economic sense. This is particularly the case when standards of social justice are violated: what may make a particular injury unacceptable, for instance, may not be (only) its cost, but also the fact that it could have been prevented but was not, due to the employer's obsession with making the greatest possible profit.

Private vs. Social Cost: All the costs of worker ill-health, to whomever they might accrue, could be added up; this sum would be the full social cost. Society has traditionally been thought of as equivalent to the nation, but it makes increasing sense to think of the entire world as our society, due to economic integration. Within this overall accounting, however, costs fall on different parties. The particular portion of the cost paid by any one individual or organization is called the private cost, and this is the cost relevant for decision-making on that level insofar as the decision-maker is economically rational. Three points should be borne in mind. First, private costs do not necessarily enter into the social cost, because they may be offset by benefits to other members of society. Suppose, as a result of a catastrophic industrial accident, a firm loses half its market share. This constitutes an enormous private cost to the firm, but if the sales are taken up by other firms this is not a component of social cost. If the firm suffering the accident was more efficient than its competitors, however, the increase in the cost to society of supplying the goods (a much smaller sum) would qualify as social. Second, not all social costs appear as private costs. For instance, a significant portion of the medical cost of occupational injury and disease in the industrialized countries is indemnified by social insurance systems. Some of it can ultimately be traced to specific contributors, but the cost may be so spread out as to be invisible at the private level. Moreover, imagine that the insurance system borrows money to finance the extra cost, and that the ultimate effect is to reduce the funds available for other projects. Rather than pursue such hopeless investigations, it can simply said that the cost is social but not private. Third, the possibility for social costs to be borne by one group or another gives rise to the concept of cost-shifting. A firm, for instance, may try to reduce its exposure to OSH costs by shifting some of them to their workforce, to other firms, or to society as a whole. This is another reason why studying private costs may be a poor guide to social costs. Nevertheless, for the purpose of understanding why individuals and firms behave the way they do, the study of private costs is indispensable.

Financial vs. Implicit Cost: All economic costs could be expressed in monetary units, but not all take the form of actual money changing hands. When monetary payments are made, financial (or out-of-pocket) cost may be a subject, but these are often dwarfed by costs that can be inferred from their effects and given estimated monetary values. Consider, for example, an accident to a worker that results in medical treatment as well as damage to a machine. The firm may pay real money to the health care provider; this is a financial cost. But if the useful life of the machine is reduced by two years, and if there is no other factor to attribute this to other than the accident, the increased depreciation is also a cost, just as real despite being an inference. Ultimately, from an economic point of view, financial costs are potentially deceptive, since, as we have seen, they may be more or less than true social cost. Only the inferred cost of an event in terms of all its impacts on society, based on full information and careful analysis, can be a satisfactory basis for social cost. Economists refer to this as the opportunity cost, the difference between the value of the goods and services available to society with or without the event, decision, etc. Calculating opportunity cost is a difficult enterprise and usually depends on a willingness to make questionable assumptions but, economically speaking, there is no alternative.

3.1 The Economic Cost to Enterprises

It is a principle of health and safety management that the vast majority of accidents are attributable to the conditions of work, not the performance of work. In a sense, this is a semantic dispute, since even highly dangerous conditions might be regarded as safe if work were always performed with exacting attention and precision. But the goal of OSH management is to make the job appropriate to the capacities of the workforce, not to find ways to exclude most workers from most jobs. Hence it is customary to view the decisions of the employer concerning what production methods to use, how to implement them, and how to incorporate safety and health concerns as the decisive focus of OSH policy. From this perspective, the reason that why economic costs of poor working conditions are interested in, is that they provide the material incentives for improving those conditions.

Not all costs will do, however. There has been considerable confusion surrounding how to classify the costs to firms, and here economic theory is invoked to distinguish between costs that do or do not enter into these incentives. In brief, to provide effective incentives for the improvement of safety and health conditions, the costs of ill-health must be economic, internal, variable, and routinely visible. Each of these is important and deserves a brief discussion.

Economic vs. Non-economic Costs: Recalling that economic costs are those which can be expressed in monetary units, it is clear that not all such costs involve financial payments. Some can be attributed through careful analysis of production, such as the impact of an accident on the depreciation of capital equipment or the loss of raw material. Ultimately, these come down to a set of payments, but it may take a careful study to determine what portion of the payment is attributable to workplace accidents. Other costs are what economists call "opportunity costs", the value of the opportunities lost to the firm due to worker absences or other forms of disruption due to ill-health. If a firm loses market share, for instance, this is really the cost of not enjoying the benefits of the higher market share that would otherwise have been possible. Finally, many intangible costs can readily be given monetary values; this is common, for instance, in the case of "goodwill", which is a valuable attribute for a firm. The loss of goodwill, which may result from well-publicized cases of industrial accidents or disease, is an opportunity cost to the firm which can have serious economic consequences. Nevertheless, there are also costs, quite real to the firm and its managers, which are not reducible to economics. If a worker is hurt on the job, for example, the manager responsible for establishing working conditions may feel remorse, being human; it would be difficult to feel otherwise. These non-economic motivations, which include sympathy, solidarity, and a sense of propriety (desire to adhere to social norms), may be quite powerful, but they are outside the scope of economic analysis. Here the firm is considered as an organization whose goal is to acquire profit and avoid loss. Clearly this is an incomplete description, but economics is one of many approaches to understanding the behaviour of human beings within organizations.

Internal vs. External Costs: This distinction is implicit in the earlier one between private and social costs and in the discussion of cost-shifting. An internal cost to the firm is a cost which it must pay; an external cost is one which is attributable to the activities of the firm but is paid by others external to it. (Workers, incidentally, are financially external to the firm they work in, a point that will be returned later.) Suppose, for instance, a company experiences a certain number of occupational illnesses each year due to a compound it uses in painting, and that the potential remedy consists in buying another safer but more expensive compound. Upon examination, managers see that they pay an extra $1 million in medical and indemnity costs, which is costs they could avoid by switching paint formulas. This might provide enough incentive to make the change, or it might not. If the firm cares only about profits (and therefore economic costs), its decision will depend on whether the extra cost of the new paint is more or less than $1 million. Let us say that it costs $2 million to switch paints. In that case it is not in the company's immediate financial interest to solve their exposure problem. Yet, a large portion of the economic costs of injuries and illnesses do not fall on employers; they are paid by workers, their families, and their communities, this in addition to the non-economic costs which, by definition, cannot show up on the firms' books. Let us suppose that these extra costs amount to another $2 million, effectively tripling the total social cost. A $2 million investment to save $3 million is a good bargain for society, but not for the firm, since it stands to lose. In this example, the internal cost is $1 million, the external cost is $2 million, and the total social cost is $3 million.

Economic theory tells that the existence of external costs drives a wedge between the incentives of individual decision-makers, such as enterprises, and the interests of the wider community. Environmental pollution is often given as an example, but the costs of injuries and illnesses suffered on the job could serve just as well. A partial list of the components of external cost appears as:

- Victim's lost wages, concurrent and future, not replaced through workers' compensation,
- Victim's medical expenses not compensated through workers' compensation or other employer-paid insurance,
- Time and resources expended by the victim's household in nursing and recuperation,
- Lost household production by the victim,
- Public medical subsidies applied to health services received by the victim,
- Environmental contamination in the vicinity of the enterprise,
- Productivity no longer available to society due to premature death (if not captured by lost wages).

The next-to-last of these, environmental contamination, deserves special consideration, since there is a tendency to overlook the connection between the workplace and wider ecosystem. Hazardous substances do not read signs proclaiming private property and do not enter; they migrate readily by air and water between production sites and residential areas. The risk is compounded by the usual pattern in which neighbourhoods spring up around factories, mines and other places of employment. This is particularly common in developing countries, where industrialization and urbanization are part of the same phenomenon. The result can be a awful disaster, as in Bhopal, India; literally hundreds (and perhaps more) died from an accident in a fertilizer plant. But the routine emission of pollutants can also create an insidious problem, undermining the health of workers in their own homes. The implication for cost analysis is this: depending on the production methods and control processes involved, the same factors that generate risks of injury and illness on the job generate risks off the job, and with few exceptions these wider ecological costs will be externalized. The polluter pays principle is more honoured in the breach, and even when massive attention causes a company to pay some of the direct costs of an environmental disaster, as occurred after the Bhopal episode, these payments cover only a fraction of the full cost (Dorman 2000). Even with the best of intentions, however, it is often difficult to trace specific environmental health outcomes to individual enterprises or production methods. These costs, increasingly recognized as serious, will be paid mostly by families and communities, not businesses.

Fixed vs. Variable Costs: Within the context of internal cost there is an important distinction to be made between costs that are essentially constant whatever the level of injury or disease, and those that vary with incidence. If a firm pays a fixed premium for workers compensation irrespective of its own claims rate, for example, there will be little financial incentive to improve conditions. On the other hand, if the same firm has a policy of keeping workers on the payroll even if they are absent as a result of an occupational injury or illness, and then each episode increases the motivation to keep workers healthy. The general principle is that only variable costs generate economic incentives.

Of course, it is not the actual variability of costs that influences decision-making, but the perceived variability. This is an important point in the context of OSH. In accounting terms, to be variable, OSH costs need to be allocated to the specific activities that gave rise to them; unfortunately, it is often easier to simply assign them to overhead (Hopkins, 1995). This will often be true not only of workers compensation premiums, but also the costs of production downtime, medical payments, and even the cost of the firm's OSH program itself. To assign these costs to particular activities requires more elaborate record-keeping and sometimes an additional commitment of personnel to research and analysis. The best of the modern enterprise-level cost models, however, load the indirect costs of injury and illness on the payroll expense of the employees involved, and this makes the variability of these costs transparent.

One important issue in the variability of costs deserves particular attention. Most firms maintain a certain level of ease in order to meet unexpected demands on their resources, including accidents and other working conditions-induced absences (Rundmo and Söderqvist, 1994). Because of this reserve, many of the variable costs associated with ill-health simply do not arise. A portion of this overhead cost is due, in theory, to the level of working conditions, in the sense that better conditions would reduce the need for overhead. This relationship is complex, however, and no studies have attempted to estimate it. Instead, one procedure has been to look at what might be called the variable component of this generally fixed cost: the transient expenses that occur before the reserve can be called up or that are entailed in utilizing it (transferring workers from one department to another, for example). This has been called the friction cost approach (Koopmanschap, 1994). In recent years, however, firms have begun to realize that maintaining an overhead of excess capacity is costly, not so much for the direct costs of idle equipment and personnel, but even more because the presence of planned overcapacity obscures inefficiencies in the production process. Actual disruptions to production, in this perspective, are helpful because they provide information the enterprise needs in order to locate the underlying problems and achieve continuous improvement. This is the basis for so-called lean and high-performance systems, and it is probable that they change the cost environment for OSH in dramatic ways.

Visible vs. Invisible Costs: In an older tradition within economics, individuals and organizations were represented as know all, fully-informed decision-making entities whose choices always best served their interests. In modern economics, on the other hand, the cost of acquiring information is explicitly taken into account: it is very expensive to have all the facts. This observation applies with great force to the world of OSH. As it will soon be seen, there is a large literature devoted to calculating the cost of injury and disease to the firm, with many disputes over methodology. The most important fact about this literature is that it exists: without special studies by trained experts, many if not most of the costs of poor working conditions would never be identified. There is no corresponding literature in, for instance, the cost of energy inputs (although there is a literature on controlling these costs), because the money paid for energy is known without any extra effort.

To make matters even more complicated, in the literature on cost analysis there is an important distinction between direct and indirect costs and a tendency for each author to draw it somewhat differently. A typical approach is to simply list the costs that will qualify as direct, and assign all the rest to indirect. Since each industry is unique in terms of the kinds of costs it generates and the channels through which they are paid, it is not surprising that no two lists are the same. Another solution is to separate costs reimbursed by insurance from those not reimbursed (Simonds and Grimaldi, 1989).

Although not exactly the same, the lists of direct and indirect costs resulting from this approach will be similar to those found in most of the literature. Insurance premiums, legal settlements, and direct payment to physicians will typically be examples of direct costs at the company level. Indirect costs are just as real, but they must be inferred from close observation and calculation. Thus, if a machine has a shorter lifespan because it was involved in an industrial accident, this is a hard economic cost, but it may be one that goes unnoticed unless someone takes the extra time to measure and allocate the damage.

Possible indirect costs at the company level can be listed as:

- Interruption in production immediately following the accident,
- Morale effects on co-workers,
- Personnel allocated to investigating and writing up the accident,
- Recruitment and training costs for replacement workers,
- Reduced quality of recruitment pool,
- Damage to equipment and materials (if not identified an allocated through routine accounting procedures),
- Reduction in product quality following the accident,
- Reduced productivity of injured workers on light duty,
- Overhead cost of spare capacity maintained in order to absorb the cost of accidents.

In using a list like this, it is important to remember that, in specific situations, a cost item may switch categories depending on the details of the payment mechanisms and accounting system.

The failure to identify and take into consideration these costs can have a profound impact on a company's willingness to invest in workplace safety and health. Estimates of indirect costs as a proportion of direct costs have ranged from less than 1:1 to more than 20:1, depending on the specific industry and methodology of the researcher, although the recent trend is for ratios much closer to the lower end of this spectrum. In general, a firm that fails to calculate the full cost it pays for poor working conditions operates under the misleading perception that it has less incentive to remedy them. Without realizing it, the firm may be undermining its economic as well as physical health.

Summary of the four cost distinctions which are explained above is given in Table 3.1.

Table 3.1 Distinctions in the Cost of Occupational Accidents and Diseases

Distinction	Criteria	Significance
Economic / non-economic	whether the cost takes the form of damage to goods or services that have or can be given prices	determines the economic case for intervention, apart from the ethical and public health case
Internal / external	whether the cost is paid by the economic unit that generates it	determines the gap between the economic incentive to the individual decision-maker and the corresponding incentive to society
Fixed / variable	whether the cost remains constant despite changes in the incidence and severity of injuries and illnesses	determines the economic incentive for an individual decision-maker to take measures to reduce incidence or severity rates
Direct / indirect or visible / invisible	whether the cost is measured and allocated through routine accounting methods	determines whether the decision-maker will perceive the economic incentives that actually exist

3.2 Costs of Occupational Injury and Disease at the National Level

For generations, public policies in the field of OSH were justified on the basis of public health and social justice. Occasionally, advocates would assert that safer work was also more productive work, or that human carnage in industry was an economic burden on society as a whole, but no research was conducted to actually measure these impacts. In the 1990s this started to be changed. The economics of OSH at the national level was given serious attention in a number of countries, and major studies were mounted to satisfy the demand for quantitative estimates to put numbers on the faces of the dead and disabled.

From an economic standpoint, the total cost to an economy occupational morbidity and mortality is the sum of all private economic costs that are also social costs, plus the social costs that are external to all private parties. Suppose, for instance, that an injury to a worker results in lost output. If the worker is paid during the period of non-production, this mitigates the private cost to the worker but increases the cost to the employer. A loss of production may lead to a loss of profits, which would then be a social as well as private cost, but the firm might have the ability to raise prices, maintain profits, and shift the cost to consumers. It is clear that there are vast numbers of considerations to take into account at the level of a specific episode of injury or disease, and that it would therefore be impractical to try to extend to the level of the nation the same techniques employed at the level of the enterprise.

Instead, the cost accounting methods typically abstract from many of the detailed questions concerning who pays what, bringing distribution back into the analysis only at the end. The fundamental concept in this work is opportunity cost-the value to society of the goods or services (including leisure) it could otherwise have enjoyed had there been no diversion of resources resulting from accidents or illness at work. In general, the main sources of opportunity cost are lost output, costs of treatment and rehabilitation, and the cost of administering the various programs to prevent, compensate, or remediate occupational injury and disease. Of these, the last two are the most readily calculated, since they are generally reported by social insurance or other similar programs. The first is more difficult. Firms often maintain a reserve of productive capacity that can absorb periodic absences or accelerated turnover due to working conditions. Moreover, there are often indirect costs of accidents and illness on productivity that firms may not even be aware of. Another problem is that, from the standpoint of the enterprise, the productive impact of, say, an accident is mitigated by the ability to hire a replacement worker; this puts an additional cost to private cost. Finally, even given the assumption that a worker will miss work and not be replaced, measurement of the impact of these on productivity is a problem. It is common in this work to assume that the worker's wage is a reasonable approximation to his productivity, but there is also cause for doubt. In particular, discrimination and other social factors often play a role in determining wage levels, and it is troublesome to think that we are reinforcing these factors when, for instance, it is assumed that men, on average, are more productive than women solely because they are paid more.

In practice, researchers tend to take the path of least resistance: they equate the wage value of lost workdays (that is, the number of days of work lost times the wage paid for that labour) with lost output to society. This is meant to signify the total of direct and indirect costs due to this lost labour. Added to the medical and administrative costs, this is the figure researchers work with. The other great difficulty, however, has to do with identifying the relevant lost workdays themselves. In the case of industrial accidents this is not too problematic, although even here there are generally gaps in record-keeping. A greater source of potential error is occupational disease. Our knowledge of the extent to which different diseases can be attributed to occupational causes is limited, most diseases are actually attributable to a multiplicity of causes, and workers' exposure is difficult to ascertain in a world in which the exposures associated with particular jobs are often not known, and in which workers frequently move from one job to another. Finally, the time lag between exposure and the onset of disease confounds straightforward attempts to measure the portion of disease attributable to working conditions.

Thus the measurements that follow are the products of two uncertainties-the insufficiently understood opportunity costs of occupational illness and injury times the insufficiently understood incidence of these conditions.

Recent national calculations for a set of European countries are given in Table 3.2. Most are in the range of 2.5-6%, with the exception of one of the Norwegian estimates at the high end and Great Britain on the low end.

Table 3.2 Estimates of the Aggregate Economic Cost of Occupational Injury and Disease for Selected European Countries

Country	Base year	Cost as % of GDP/NI
Great Britain	1996	1.4
Denmark	1990	2.5
Finland	1992	3.6
Norway	1990	10.1
Sweden	1990	5.1
Denmark	1992	2.7
Australia	1993	3.9
Netherlands	1995	2.6

Perhaps the most elaborate attempt to calculate a national economic burden was undertaken by Leigh et al. (1996) at the behest of the U.S. National Institute on Occupational Safety and Health. At this point it will be useful to go into some detail concerning their methodology and results. Using a wide range of public and private data sources, and cross-checking their estimates against those of their predecessors, the NIOSH-sponsored team accurately constructed cost totals by cause of impairment or mortality, by source of cost, and by ultimate payer for the year 1992.

As we have already seen it is not possible to do a study such as this without making a large number of assumptions many inevitably by the seat of the pants and the Leigh et al. (2004) study was no exception. Heroic assumptions were made especially in the areas of occupationally-caused disease, the indirect costs of morbidity and mortality, and the extent to which employers are able to pass on the costs of workers' compensation premiums. At most points the study team adopted a conservative bias: they deliberately sought to underestimate the cost of injury and illness, anticipating that potential criticism would come primarily from those who believe these costs to be low. Had the assumptions been neutral equally questionable to those whose prior belief is that the costs are very low or very high--the totals could easily have 25-50% higher (and therefore more in line with the majority of studies reported in Table 3.4).

3.3 Costs to the Injured Worker and Their Family

A workplace injury has direct medical, employment and earnings consequences for a worker, and these consequences are the focus of a growing literature (Leigh, et al., 1997; Miller, 1997; Miller and Galbraith, 1995; and Viscusi, 1996). Indirect costs to workers and their families may include reduced income, depletion of savings, and loss of assets (which could include automobiles or even homes). Oftentimes, indirect costs to a worker and their family will also occur in the form of lost fringe benefits and lost home production when other members of the household are required to quit or cut back on their own work hours to care for the injured family member. Additional potential costs to workers and their families include professional counseling, caregiver services in the home, home modifications and equipment related to disability and loss of education opportunities for family members.

Costs to The Community: The changed economic circumstances of the family and possible increased care required for the injured worker may also affect the economic and social outcomes and behaviors for other family members including children. Costs may also be absorbed by the community with the increased use of social services. While fatalities are the most dramatic and tragic, nonfatal injuries may still have disastrous impacts on families, often with fewer organized sources of support. Extending the literature on earnings losses for workers with injuries to losses in family income and social consequences is an area of increasing interest to occupational economics researchers.

Estimates of actual costs of occupational injuries in the industry: Occupational injuries, fatalities, and illnesses can be very costly. The International Labor Organization estimates these costs to the global economy at $1.25 trillion per year based on the calculation that accidents and work-related illnesses cost some four percent of the global gross domestic product. Other sources report that the average cost of a fatality is $2.57M to $5M (Miller and Galbraith, 1995; Viscusi, 1996), and for each $1 of direct costs, there are associated indirect costs of $3-5 (Liberty Mutual, 2003). A study of costs of injuries at sand and gravel mines estimated the average cost of nonfatal injuries to be $46,400 per incident (Camm, 2000; Camm et al., 2000). However, the actual costs may be substantially higher than what has been presented in the literature to date, and costs per incident are expected to increase in the future. For example, in March 2003 a jury awarded $163.8M to the widow and children of a contractor fatally injured at a mine (MSHA, 2003). The Liberty Mutual Research Institute for Safety (2003) also reported that the direct costs of the three leading causes of work-related injuries (for all industries) grew at rates substantially greater than inflation (12% to 17% higher) and 2.5% overall.

CHAPTER 4

ACCIDENT RELATED COST ANALYSES

4.1 Value-Added-Loss by the Accidents

Using the data existing in the yearly statistics (2006) of Social Insurance Organization total value-added loss by the job accidents and in coal mining can be calculated as follows:

Temporary incapacity days:	133555
Permanents incapacity days:	104 x 7500 = 780,000
Incapacity days due to death:	35 x 7500= 262,500
Total working days loss:	913,555
Average daily income (TL):	40.57
Total value-added loss (TL):	37,062,926.35

The figures above reveal only a part of the truth. If other costs of workplace accidents could form appropriate data to be included in these figures, the resulting amount would be much higher. Training and cultural costs are important aspects in this issue.

4.2 The Relationship Between Safety Expenses and Cost

The cost analysis of the accidents constitutes one of the important parts of Accident Preventing Program. The economic or financial approach for preventing accidents presupposes that accidents and occupational diseases represent financial losses to the employing organization. It must be well understood that if accidents are reduced, money can be saved; profits and productivity can be increased.

Accident costs should be calculated in order to see effectiveness of the accident preventing program. On the other hand, better knowledge of accident cost may contribute towards more informed decision-making if cost analysis helps to the reduction of accident.

Accident prevention then becomes a part of the standard economic activity of the company. The relationship between the money spent to prevent or reduce the accidents or occupational diseases and cost of accident may help in the determination of optimum expenditure to prevent or reduce accident and occupational diseases is shown in Figure 4.1 (Güyagüler *et al*, 2005).

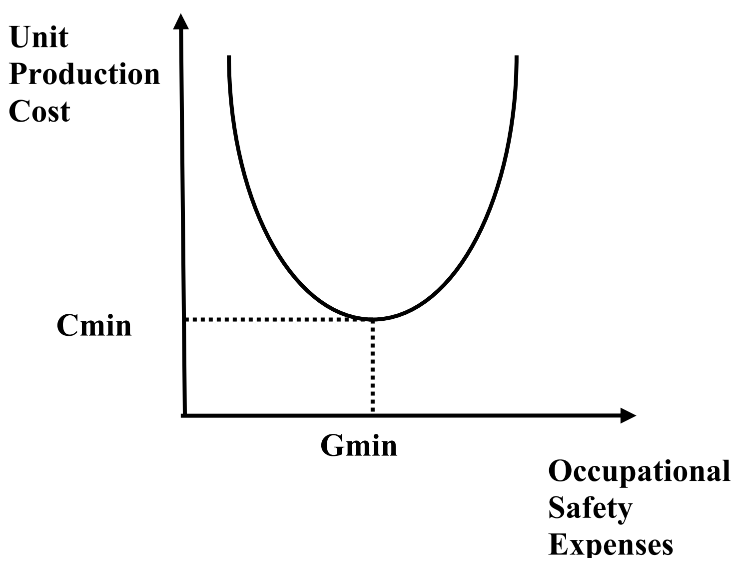

Figure 4.1 The Relation Between Occupational Safety Expenses and Costs

4.3 Cost Models Used In The USA

There are two types of cost models, namely, non-fatal and fatal cost models used in the USA (Güyagüler *et al*, 2005).

Non-fatal Accident Cost Model is given in Equation 3:

$$\text{Cost} = [L_{sn}, (b_s(100) + D\,(b_{snm} + b_{snd})/5\,] \qquad \text{Eq 3}$$

where:

- L_{sn} = the maximum benefit limit for non-fatal injury
- b_s = one time benefit loss of member in amputation (0 for all other injuries)
- D = # qualified work days on disability.
- b_{snm} = the basic weekly SWCB (State Worker Compensation Benefit
- b_{snd} = the incremental benefit for dependants

Fatal Accident Cost Model is given in Equation 4:

$$\text{Cost} = [L_{sf}\,,\, b_s\,(LS) + W_e\,(b_{sfm} + b_{sfd})\,] \qquad \text{Eq 4}$$

where:

$$W_e = 52(65 - Y_m) \qquad \text{Eq 5}$$

- L_{sf} = The maximum SWCB (State Worker Compansation Benefit) for fatality
- b_s (LS) = on time burial benefit
- b_{sfm} = max. weekly benefit to surviving spouse (if married)
- b_{sfd} = max. weekly benefit to children
- W_e = remaining expected work life of miner (weeks)

Y_m = The age of the miner at the time of accident.

The following list gives the days of charge for different types of injuries (Report of U.S Department of the Interior, 1977).

Days of Disability

Nature of Injury	Days Charge
Death	6,000
Permanent Total Disability	6,000
Permanent Partial Disability	
- Arm above elbow, including shoulder joint	4500
- Arm above wrist, at or below elbow	3600
- Hand at or below wrist, above proximal joint of fingers	3000
- Thumb, at or below proximal joint, above distal joint	600
- Thumb, at or below distal joint	300
- Thumb, metacarpal	900
One eye, loss of sight	1800
Both Eyes	6,000
One ear loss of hearing	600
Both ears	3000

In mine accidents, usually hand and foot are involved in the different types of accident. The days of disability and related parts of hand and foot is shown in Figure 4.2.

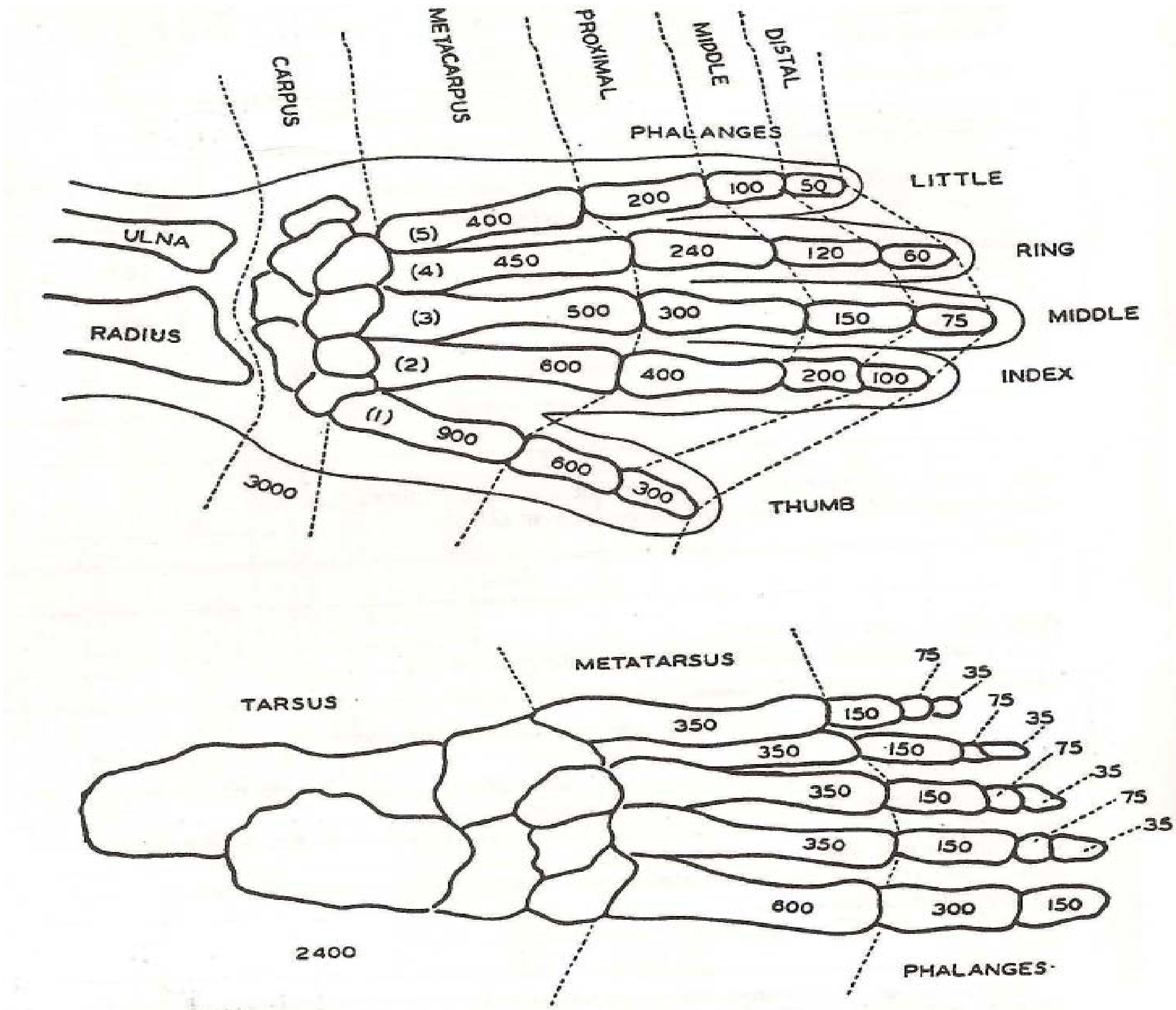

Figure 4.2 The Days of Disability and Related Parts of Hand and Foot

4.4 Utility-Cost Analysis On Company Level

The following data should be gathered in order to make sound analysis on company level:

- Number of occupational accidents
- Number of workers in job area
- Production level (Physical)
- Value of production in terms of money

Later, on company basis, Accident frequency rate and accident severity rate should be calculated as shown below:

Accident frequency rate stands for number of accidents per hour for each million worker and calculated from the formula given in Equation 1 (Güyagüler *et al*, 2005):

AFR = (Number of Accidents / Total Man-Hours of Exposure) x 1,000, 000 Eq 1

This rate is usually in the range of 5 to 10. If the 'rate is above 10, urgent and new measures should be taken in that company.

Accident severity rate stands for the loss of working days due to occupational accidents per hour for each thousand men, and calculated as Equation 2:

ASR = (Number of Days Lost / Total Man-Hours of Exposure) x 1,000 Eq 2

If the accident results in death, number of the lost working days should be taken as 7500 days per fatal accident.

Accident severity rate is generally between 0.5 and 1. In heavy industry it may go up to 2.

Each company should analyze its own situation under the light of above rates. If ASR and AFR tend to go up, some measures should be taken in the company. The company official must believe that their expenditure on occupational safety is less than the cost of occupational accidents.

4.5 Mine Accidents in Türkiye

Depending on the 2006 Annual statistics Report of Social Insurance Institution Data Table 4.1 shows the ASR and AFR values for and companies.

Table 4.1 Some Selected Accident Statistics of Türkiye for 2006

Sectors / Parameters	All Industry Sectors	Mining Sector	Coal Mining	TKİ	GLİ
Number of Workers	7818642	93566	43585	8908	2710
Number of Working Days	2449870475	29317698	13656800	2400094	723527
Number of Working Hours	19598963800	219882735	102426000	19200752	5788216
Days Lost	18837451	765696	403855	18708	8242
Number of Fatalities	1592	79	35	2	1
Number of Injuries	79027	7591	6722	214	49
ASR	0.96	3.48	3.94	0.97	1.42
AFR	4.03	34.5	65.6	11	8

Accident Frequency Rate and Accident Severity Rate of the coal mining sector are calculated as follows:

Total Number of accidents:	6,722
Number of Working Hours:	102,426,000
Number of Days Lost:	403,855
Number of Fatalities:	35

AFR = 6722 * 1,000,000 / 102,426,000 = 65.6

ASR = 403,855 * 1,000 / 102,426,000 = 3.94

Apparently, results of the both rates are much above the standards. These results show that urgent and necessary measures should be taken to obtain acceptable rates.

4.6 Analysis of Mine Accidents At GLİ

Similar analysis have been made for the accidents occurred in GLİ:

Total Number of accidents in the year 2006:	214
Number of Working Hours in the year 2006:	5,788,216
Number of Fatalities in the year 2006:	1
Number of days lost in accidents in the year 2006:	8,242
AFR:	8
ASR:	1.42

Analysis of the work place accidents of GLİ of the years 2005 and 2006 is given below. Charts and comments depend on the data considered the years 2005 and 2006 together. Basic statistics of these data is given in the Appendix 2 and Appendix 1.

4.6.1 The Distribution of the Accidents by the Types

The specifying of the accident is important due to the fact that if the distribution of the mine accidents according to their types is an important clue in application of accident preventing technique.

In Table 4.2 and Figure 4.3, distributions of mine accidents in GLİ are given. According to this data, entrapment; falling, rolling, or sliding rock or material of any kind; and machinery type accidents are mostly seen.

Table 4.2: Distributions of Mine Accidents Occurred in GLİ in Terms of Types

ACCIDENT TYPE	ACCIDENTS IN 2005		ACCIDENTS IN 2006		ACCIDENTS IN 2005 & 2006	
	#	%	#	%	#	%
Entrapment	13	15.3	12	24.5	25	18.7
Falling, Rolling, or Sliding Rock or Material of Any Kind	21	24.7	6	12.2	27	20.1
Fall of Roof, Back, or Brow/Highwall	11	12.9	4	8.2	15	11.2
Handling Material	6	7.1	5	10.2	11	8.2
Hand tools	1	1.2	3	6.1	4	3.0
Non-powered Haulage	4	4.7	3	6.1	7	5.2
Powered Haulage	4	4.7	1	2.0	5	3.7
Machinery	19	22.4	11	22.4	30	22.4
Other	6	7.1	4	8.2	10	7.5
TOTAL	85	100.0	49	100.0	134	100.0

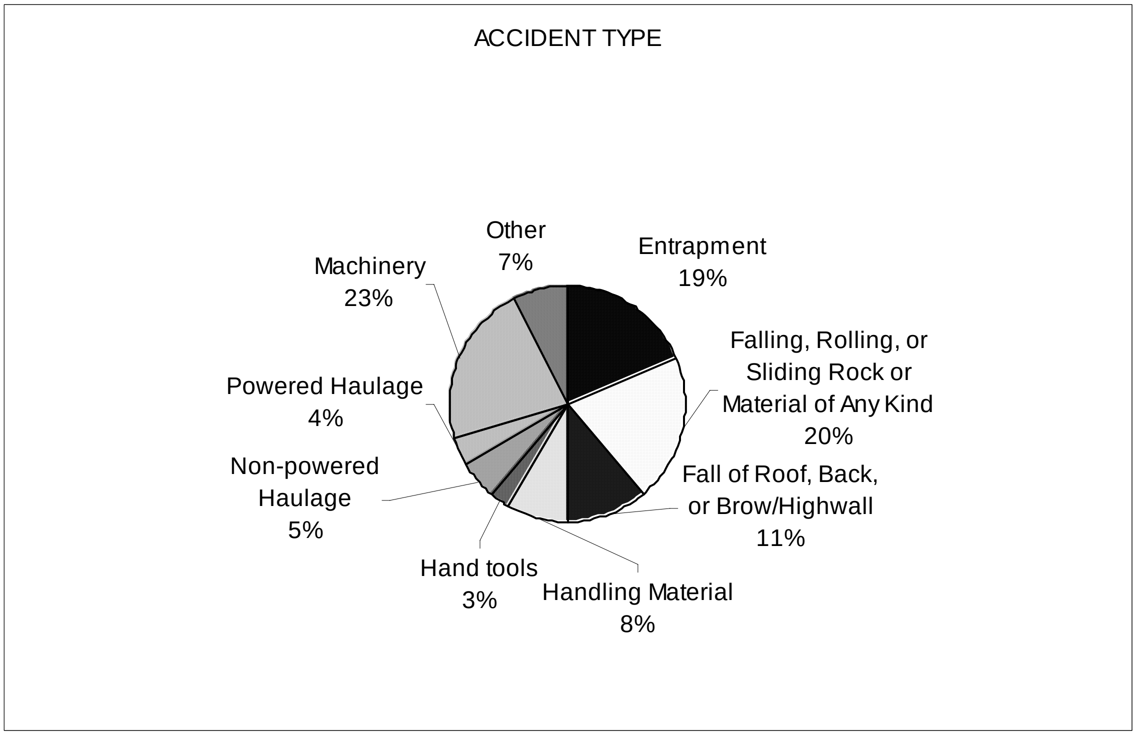

Figure 4.3 Distributions of Mine Accidents Occurred in GLİ in Terms of Types

4.6.2 The Distribution of the Accidents by the Months

The distribution of the accidents by months is shown in Table 4.3 and in Figure 4.4 Considering the years 2005 and 2006 together, December has the peak value. Also total of four months (May, September, October, and December) has 45.5 percent.

Table 4.3 The Distribution of the Accidents by Months

MONTH	ACCIDENTS IN 2005		ACCIDENTS IN 2006		ACCIDENTS IN 2005 & 2006	
	#	%	#	%	#	%
January	2	2.4	3	6.1	5	3.7
February	6	7.1	1	2.0	7	5.2
March	4	4.7	5	10.2	9	6.7
April	4	4.7	7	14.3	11	8.2
May	10	11.8	4	8.2	14	10.4
June	5	5.9	3	6.1	8	6.0
July	10	11.8	2	4.1	12	9.0
August	7	8.2	1	2.0	8	6.0
September	10	11.8	5	10.2	15	11.2
October	10	11.8	5	10.2	15	11.2
November	8	9.4	5	10.2	13	9.7
December	9	10.6	8	16.3	17	12.7
Total	85	100.0	49	100	134	100.0

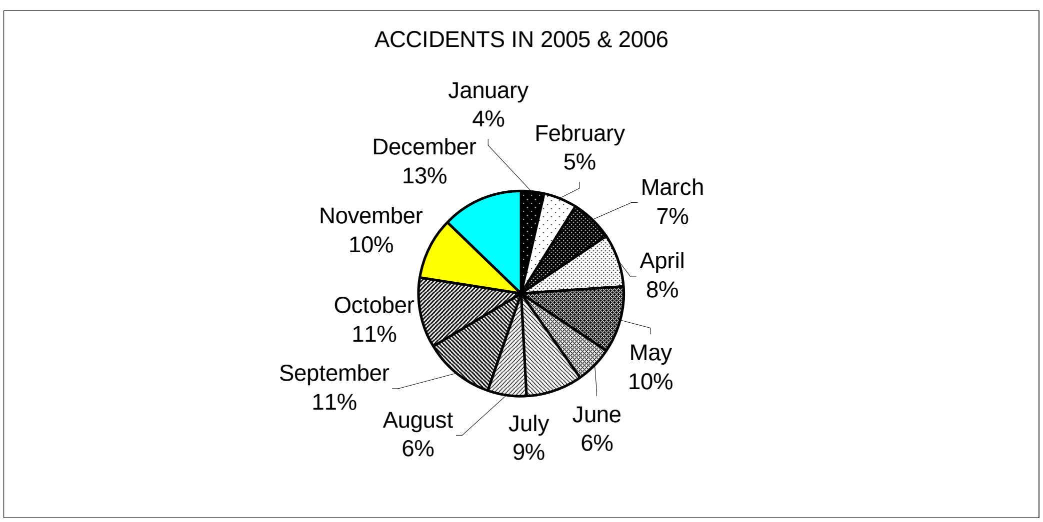

Figure 4.4 The Distribution of the Accidents by Months

4.6.3 The Distribution of the Accidents by the Days of the Week

The distribution of the accidents by the days of the week is shown in Table 4.4 and in Figure 4.5. Monday and Tuesday have the highest percentage, 19.4 and 18.7 percent respectively. Wednesday and Friday both have 17.2 percent and Thursday has 14.9 percent of the accidents. There is no reliable result we have because there is not enough data on shift changing days which are considered as the most critical days.

Table 4.4. The Distribution of the Accidents by the Days

DAY	ACCIDENTS IN 2005		ACCIDENTS IN 2006		ACCIDENTS IN 2005 & 2006	
	#	%	#	%	#	%
Monday	14	16.5	12	24.5	26	19.4
Tuesday	15	17.6	10	20.4	25	18.7
Wednesday	15	17.6	8	16.3	23	17.2
Thursday	11	12.9	9	18.4	20	14.9
Friday	18	21.2	5	10.2	23	17.2
Sunday	2	2.4	0	0.0	2	1.5
Saturday	10	11.8	5	10.2	15	11.2
Total	85	100.0	49	100.0	134	100.0

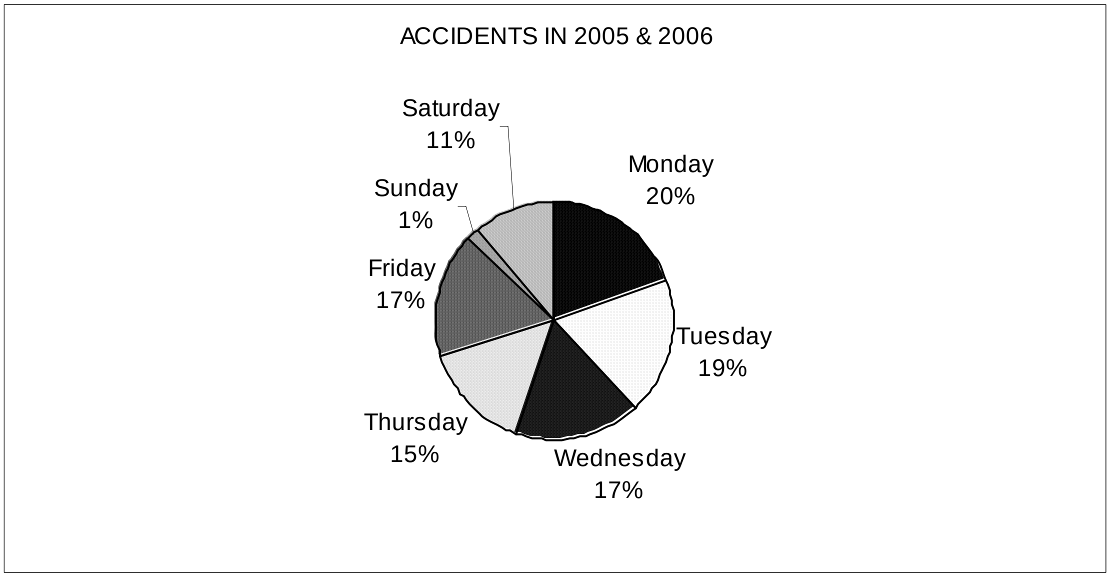

Figure 4.5 The Distribution of the Accidents by the Days of Occurrence

4.6.4 Distribution of the Accidents by the Part of Body

The distribution of the injuries based on the parts of the body is shown in Table 4.5 and in Figure 4.6. Six body parts are involved in this classification. Those are hand and finger, foot, leg, body, arms, and head. The most common injured parts are the foot which accounts 34.3 percent of the total injuries and hand and finger which accounts 26.1 percent of the total injuries. Probable reasons for these much injured parts of the body are falling of ground, coal and rocks cought in, on or between something.

Table 4.5 The Distribution of the Injuries Based on the Parts of the Body Involved

PART OF BODY INJURED	ACCIDENTS IN 2005		ACCIDENTS IN 2006		ACCIDENTS IN 2005 & 2006	
	#	%	#	%	#	%
Head	15	17.6	6	12.2	21	15.7
Hand and Finger	21	24.7	14	28.6	35	26.1
Foot	30	35.3	16	32.7	46	34.3
Leg	3	3.5	2	4.1	5	3.7
Arms	1	1.2	1	2.0	2	1.5
Body	9	10.6	8	16.3	17	12.7
Various	6	7.1	2	4.1	8	6.0
Total	85	100.0	49	100.0	134	100.0

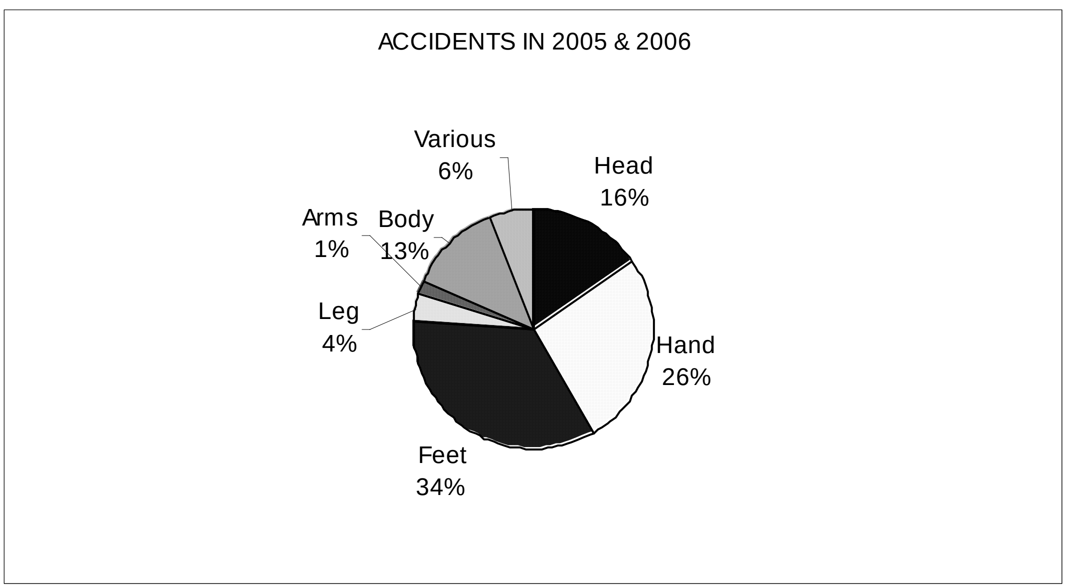

Figure 4.6 The Distribution of Injuries Based on the Parts of the Body Involved

4.6.5 The Distribution of the Accidents by the Shifts

The distribution of the accidents by the shifts is shown in Table 4.6 and in Figure 4.7. Shift 2 (08:00-16:00) has the highest percentage as almost most of the mining activities take place in this shift and most of the employers work in this shift. Shift 1 (00:00-08:00) has the least amount since only repairing and development works take place in this shift.

Table 4.6 The Distribution of Accidents by the Shifts

SHIFTS	ACCIDENTS IN 2005		ACCIDENTS IN 2006		ACCIDENTS IN 2005 & 2006	
	#	%	#	%	#	%
Shift 1 (00:00-08:00)	9	10.6	10	20.4	19	14.2
Shift 2 (08:00-16:00)	54	63.5	31	63.3	85	63.4
Shift 3 (16:00-00:00)	22	25.9	8	16.3	30	22.4
Total	85	100.0	49	100.0	134	100.0

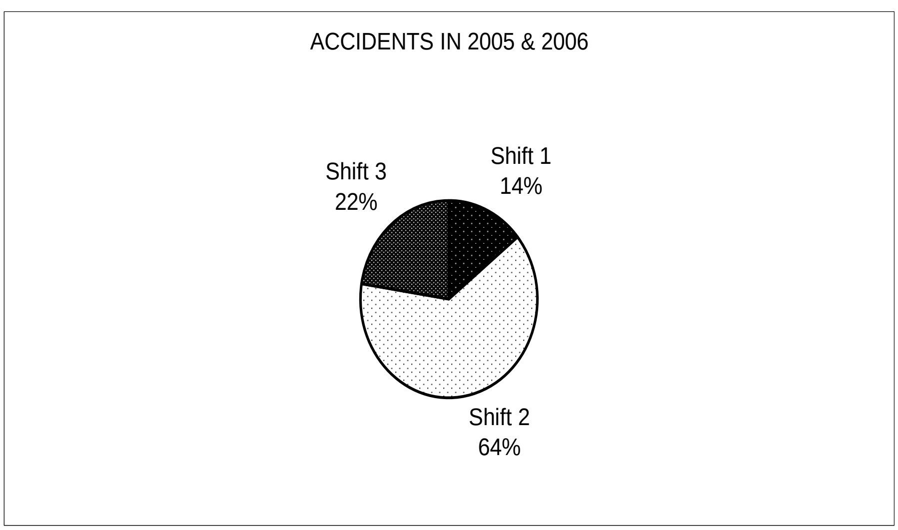

Figure 4.7 The Distribution of Accidents by the Shifts

4.6.6 Distribution of the Accidents by the Job Titles

The distribution of the accidents by the job title is shown in Table 4.7 and in Figure 4.8. In terms of the number of the injuries based on job title, six occupations account for 64.3 percent of the injuries. The frequencies of the coal winner, supporter, worker (underground and surface), repairmen and development worker injuries account for 65.8 percent of the total injuries.

Table 4.7 The Distribution of the Accidents by the Job Title

JOB TITLE	ACCIDENTS IN 2005		ACCIDENTS IN 2006		ACCIDENTS IN 2005 & 2006	
	#	%	#	%	#	%
Ordinary Worker (U/G)	8	9.4	17	34.7	25	18.7
Coal Winner	12	14.1	9	18.4	21	15.7
Scalingman	2	2.4	0	0.0	2	1.5
Repairman	8	9.4	2	4.1	10	7.5
Fitter (mech. & electric)	3	3.5	1	2.0	4	3.0
Development Worker	3	3.5	1	2.0	4	3.0
Foreman	1	1.2	1	2.0	2	1.5
Conveyorman	3	3.5	0	0.0	3	2.2
Other(U/G)	7	8.2	1	2.0	8	6.0
Ordinary Worker (Surface)	6	7.1	3	6.1	9	6.7
Maneuverer	0	0.0	1	2.0	1	0.7
Repairman (Surface)	16	18.8	1	2.0	17	12.7
Driver	1	1.2	0	0.0	1	0.7
Operator	3	3.5	4	8.2	7	5.2
Auxiliary Works	8	9.4	7	14.3	15	11.2
Other (Surface)	4	4.7	1	2.0	5	3.7
Total	85	100.0	49	100.0	134	100.0

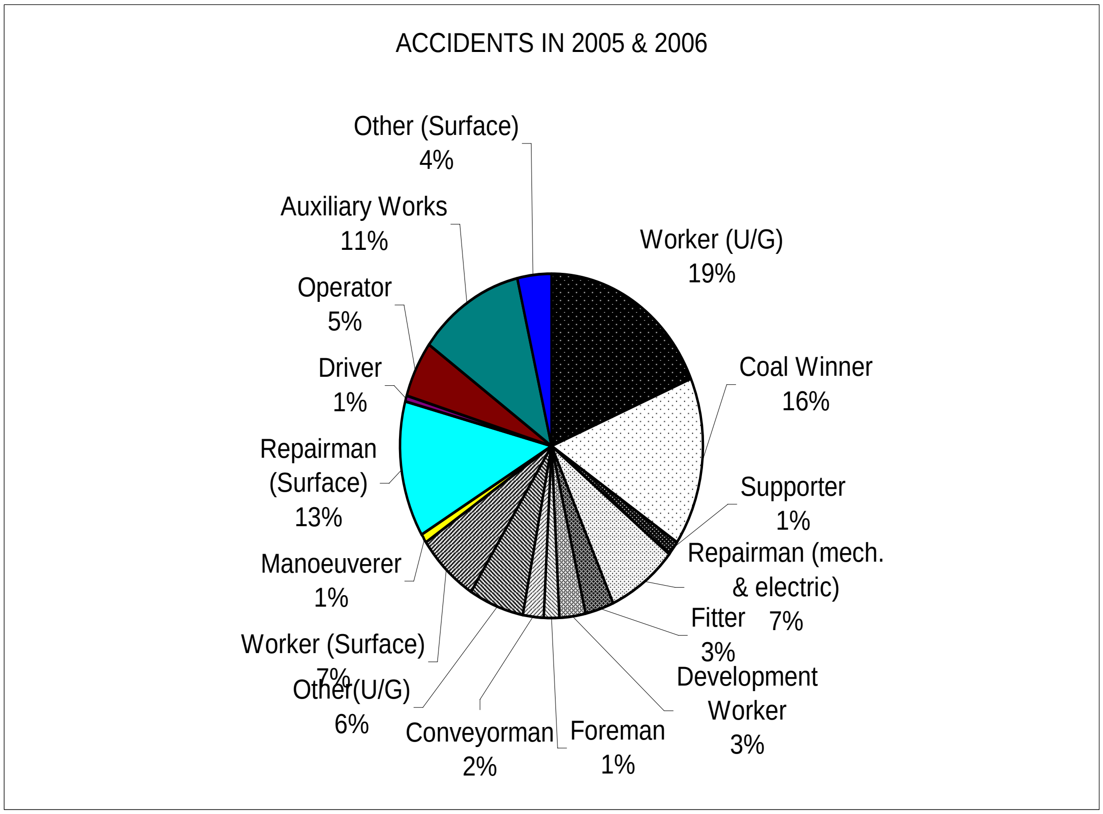

Figure 4.8 The Distribution of Accidents by the Job Title

4.6.7 Distribution of the Accidents by the Age Groups

The distribution of the accidents by the age groups is shown in Table 4.8 and in Figure 4.9. The related data is obtained after the years 2005 and 2006. The workers between the age group 40-44 have the highest percentage, 41.8 percent. The second age group is 45-49 having the highest percentage, 38.8 percent. A probable reason for this, the workers which are 40-49 years old think that they know everything they do and they are sure that they take every necessary precaution. Also employment policy of TKİ may be another reason. Because employment needs of the mine has not been satisfied for 10 years, that is no new employers are employed.

Table 4.8 The Distribution of the Accidents by the Age Groups

AGE GROUPS	ACCIDENTS IN 2005		ACCIDENTS IN 2006		ACCIDENTS IN 2005 & 2006	
	#	%	#	%	#	%
25-29	1	1.2	0	0.0	1	0.7
30-34	0	0.0	0	0.0	0	0.0
35-39	14	16.5	2	4.1	16	11.9
40-44	31	36.5	25	51.0	56	41.8
45-49	33	38.8	19	38.8	52	38.8
50-54	4	4.7	3	6.1	7	5.2
54-59	2	2.4	0	0.0	2	1.5
Total	85	100.0	49	100.0	134	100.0

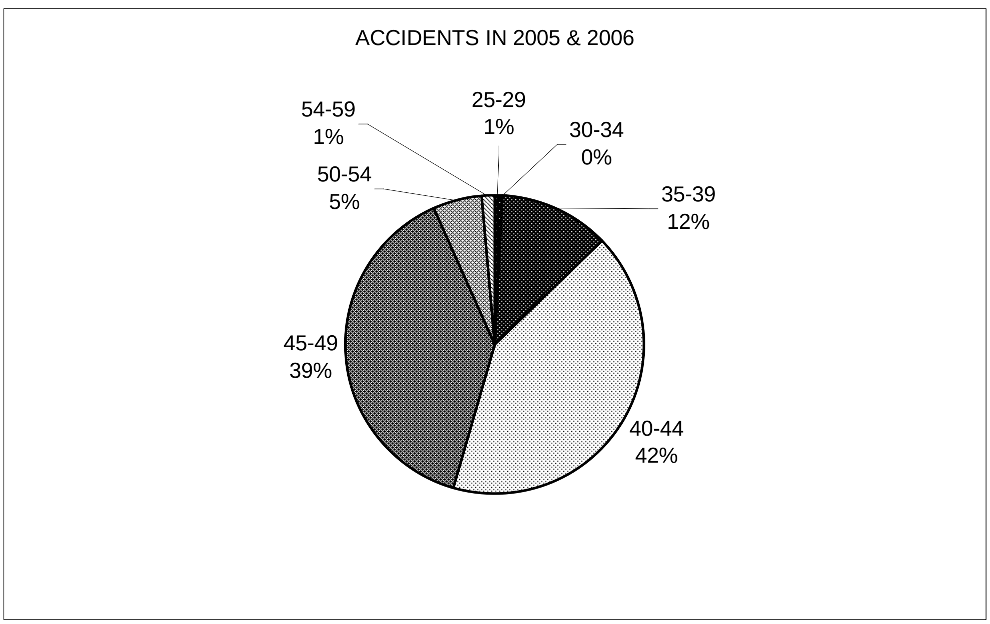

Figure 4.9 The Distribution of the Accidents by the Age Groups

4.6.8 The Distribution of the Accidents by the Place of Accident

The distribution of the accidents by the place of accidents is shown in Table 4.9 and in Figure 4.10. Considering the years 2005 and 2006 together, face area is the place that most of the accidents (33.6 percent) takes place. Relatively high work load on this area is basic reason of the rank. Also roadways and open pit areas have relatively high percents (14.9 and 17.9 respectively).

Table 4.9 The Distribution of the Accidents by the Place of Accidents

PLACE	ACCIDENTS IN 2005		ACCIDENTS IN 2006		ACCIDENTS IN 2005 & 2006	
	#	%	#	%	#	%
Face Area	23	27.1	22	44.9	45	33.6
Developments	8	9.4	4	8.2	12	9.0
Roadways	15	17.6	5	10.2	20	14.9
Workshops	11	12.9	5	10.2	16	11.9
Coal Preperation Facilities	6	7.1	5	10.2	11	8.2
Warehouses	1	1.2	1	2.0	2	1.5
Social Facilities	4	4.7	0	0.0	4	3.0
O/P Mining Area	17	20.0	7	14.3	24	17.9
Total	85	100.0	49	100.0	134	100.0

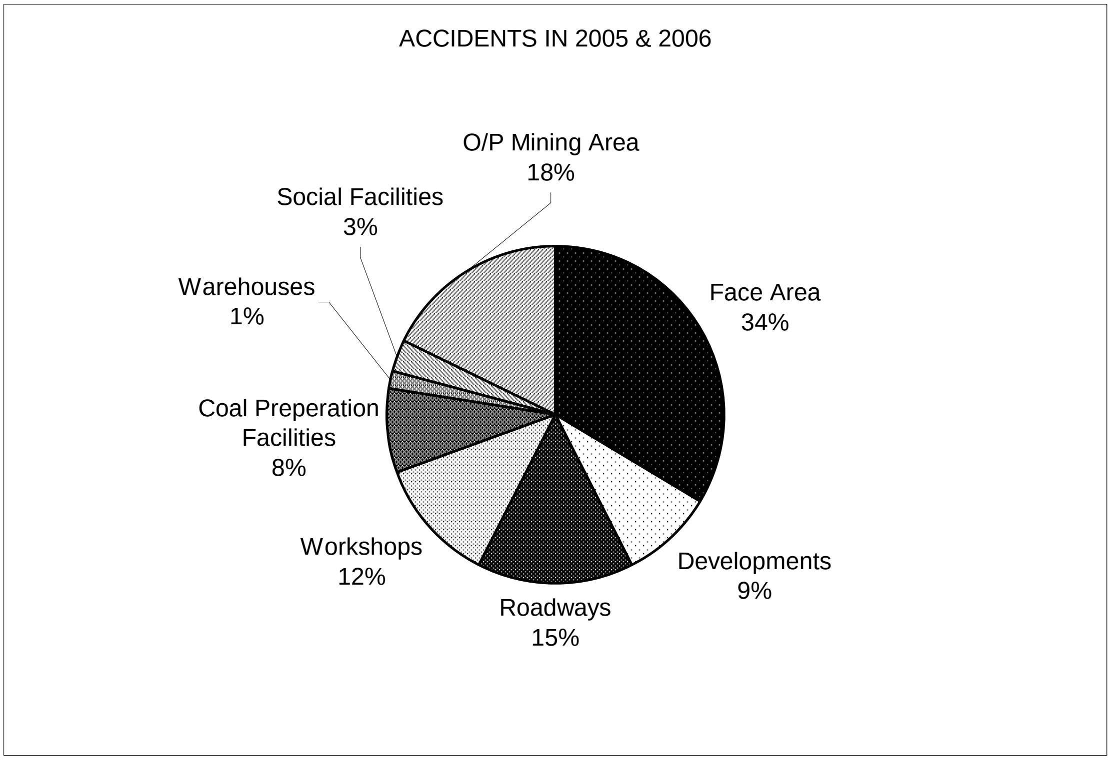

Figure 4.10 The Distribution of the Accidents by the Place of Accidents

4.6.9 The Distribution of the Accidents by the Time Interval of Accident

The distribution of the accidents by the time interval of accidents is shown in Table 4.10 and in Figure 4.11. Considering the years 2005 and 2006 together, it can be seen that the accident densely occurred in the time interval of 08:00 – 14:00 (53.7 percent). This time interval is in the first shift and most of the production activities is shift.

Table 4.10 The Distribution of the Accidents by the Time Of Occurrence

TIME INTERVAL	ACCIDENTS IN 2005		ACCIDENTS IN 2006		ACCIDENTS IN 2005 & 2006	
	#	%	#	%	#	%
00:00 – 02:00	1	1.2	2	4.1	3	2.2
02:00 – 04:00	3	3.5	4	8.2	7	5.2
04:00 – 06:00	4	4.7	2	4.1	6	4.5
06:00 – 08:00	2	2.4	2	4.1	4	3.0
08:00 – 10:00	15	17.6	8	16.3	23	17.2
10:00 – 12:00	16	18.8	15	30.6	31	23.1
12:00 – 14:00	11	12.9	7	14.3	18	13.4
14:00 – 16:00	11	12.9	1	2.0	12	9.0
16:00 – 18:00	6	7.1	2	4.1	8	6.0
18:00 – 20:00	11	12.9	3	6.1	14	10.4
20:00 – 22:00	5	5.9	2	4.1	7	5.2
22:00 – 00:00	0	0.0	1	2.0	1	0.7
Total	85	100.0	49	100.0	134	100.0

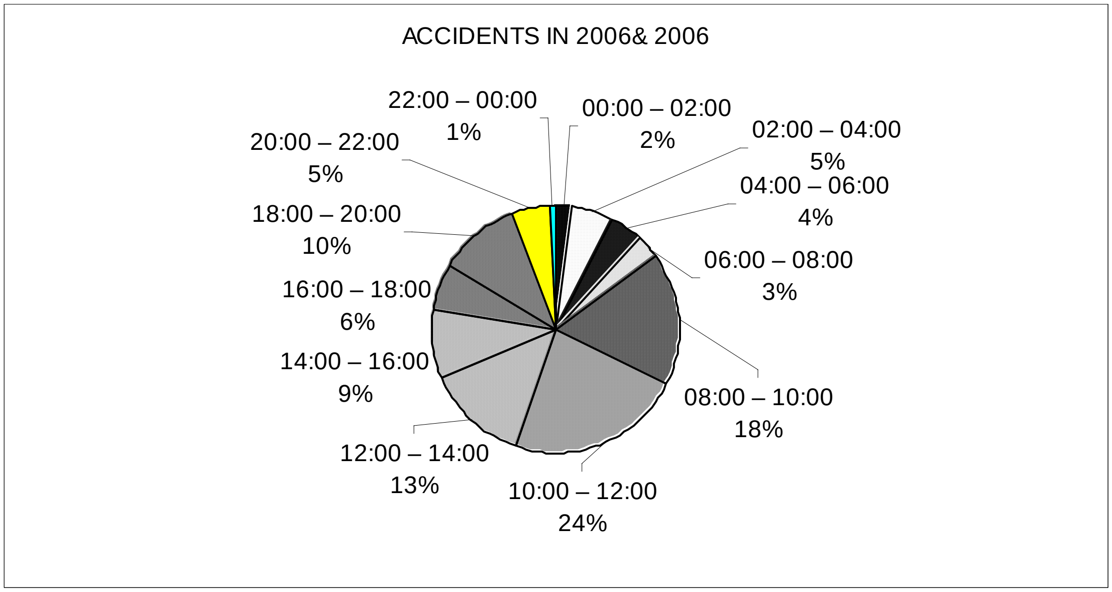

Figure 4.11 The Distribution of the Accidents by the Time Occurrence

4.6.10 Underground vs. Surface

The distribution of the accidents is shown in Table 4.10 and in Figure 4.11. Considering the years 2005 and 2006 together, it can be seen that accidents mostly occurred in underground facilities. The main reason is the characteristics of the works and work places.

Table 4.11 The Distribution of the Accidents According to Operation Type

U/G vs Surface	Underground		Surface		Total	
	Fatality	**Injury**	**Fatality**	**Injury**	**Fatality**	**Injury**
2005	0	46	0	39	0	85
2006	0	31	1	18	1	49
Total of 2005 & 2006	0	77	1	57	1	134

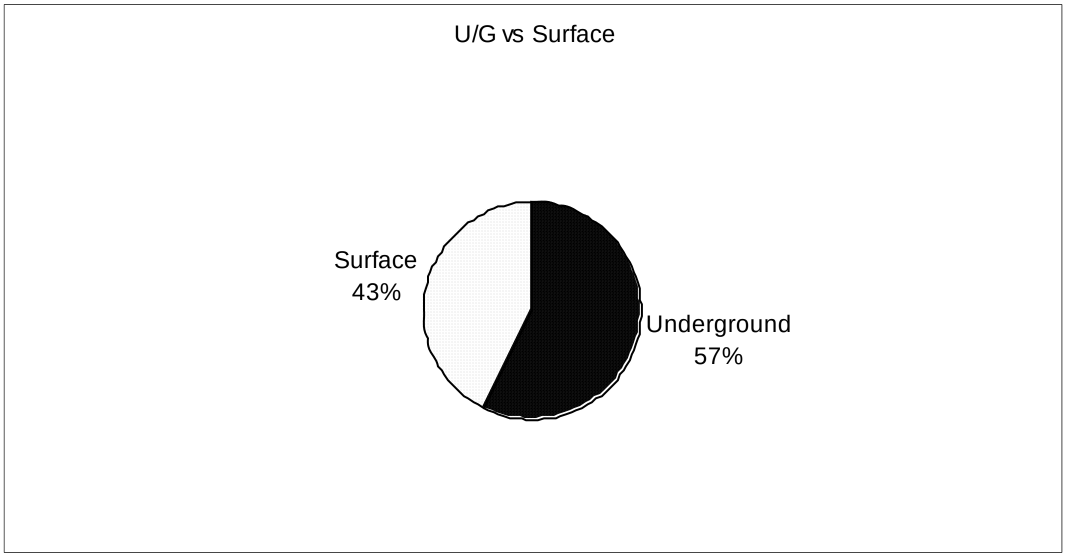

Figure 4.12 The Distribution of the Accidents According to Operation Type

4.7 Cost Analysis of Mine Accidents at GLİ

Work place accident data for the year 2006 of GLİ is given below:

Total Number of accidents:	214
Number of Working Hours:	5,788,216
Number of Fatalities:	1
Number of days lost in accidents:	8,242
AFR:	8
ASR:	1.42

By using these data, cost parameters can be calculated. There may be 2 approaches at this point. First, cost can be calculated by using production parameters, secondly by using days lost.

Calculation considering production parameters:

Daily Average efficiency:	5 ton coal/man/day
Total of Tons of Coal = 8242 x 5 =	41210 tons of coal
Price of 1 ton coal:	30 TL
Total Cost = 41210 x 30	1,236,300 TL / year.

Calculation considering days lost and daily income:

Number of days lost in accidents:	8242
Average daily income in coal mining:	62.14 TL
Total Cost = 8242 x 62.14 =	512,157.88 TL

These figures above show the monetary value of unfulfilled coal production due to occupational accidents and cost of days lost in today's prices. This value is only one factor that makes up indirect costs. It is clear from this result that a cost which is based on sound data will achieve much higher values.

4.7.1 Case Study I

For the case studies, only filled blanks are mentioned here. The original form of the reports given in the Appendix 1.

While transporting the excavator, the worker was fallen down by the cable feeding the excavator. After falling down, a dozer’s (which is used for preventing the cable from dragging) tire passed over the worker’s left shoulder part. After the accident worker was immediately referred to hospital but died on the same evening.

Occupational Safety Officer Cost Data Report

1. Name of the Employee: Mehmet Solmaz

2. Job Title: Manoeuverer

3. Section : Open Pit/ 48 C- 5

4. Accident Date & Time: 10/04/2006 17:30

5. To Whom He/She Reports: Mining Engineer

6. Is There Injury Yes (X) No ( )

If Yes;
Detail the Accident:

While transporting the excavator, the worker was fallen down by the cable feeding the excavator. After falling down, a dozer's (which is used for preventing the dragging of the cable) tire passed over the worker's left shoulder part. After the accident worker was immediately referred to hospital but died on the same evening.

7. The working time lost by the employee on the day in which accident occurred:
6 Hours, 30 Minutes

8. If the production stops for a given period of time, was it necessary to work overtime to fulfill the production loss?

Yes (   )   No (X)

9. How many employees?

Not Applicable

10. Explain the damage on the equipments and materials.

Not Applicable

11. How many employees stopped work by the damaged equipments or injured person/persons?

Not Applicable

12. During the accident period, how many employees lost time by talking, watching the accident and/or by helping the injured person/persons?

6 Employees

Time Lost: 6:30 + 6 x 1:15 = 14 Hours.

13. How many hours and minutes did the supervisor lost by helping the injured person/s, investigating, writing report, reordering jobs, training the new employee to be worked instead of injured person?

2 Hours 30 Minutes

14. How and by whom was the injured person taken from the place that the accident occurred to the first aid station?

The injured worker was carried away by means of two people and was taken to hospital.

Accident Cost Report

1. Name of the Employee:	Mehmet Solmaz
2. Job Title :	Manoeuverer
3. Section:	Open Pit/ 48 C- 5
4. Accident Data & Time:	10/04/2006 17:30
5. To whom He/She Reports:	Mining Engineer
6. Wage Per Hour :	8 TL/hour

7. Did the Accident;

Cause the time lost?	Yes (X)	No ( )
Cause to doctor's care?	Yes (X)	No ( )
Cause only to first aid ?	Yes ( )	No (X)

If an injury took place, detail the accident.

While transporting the excavator, the worker was fallen down by the cable feeding the excavator. After falling down, a dozer's (which is used for preventing the dragging of the cable) tire passed over the worker's left shoulder part. After the accident worker was immediately referred to hospital but died on the same evening.

8. Except in the disability payment example, the cost of working time lost in terms of pay during the time period the injured worker is paid.

a Working time lost during the days of the accident when the worker was fully paid.

6 Hours 30 Minutes

b. Number of days the worker was paid following the accident.

Not Applicable.

c. Number of visits to the hospital for medical examination after starting work

Not Applicable.

d Outside these, the period spent was paid but was not working.

Not Applicable.

9. Was the work which the injured worker had to be completed by overtime after the accident?

Not Applicable.

10. Lost of overtime to overcome production loss.

Not Applicable.

11. The type of damage in the machinery and equipment.

Not Applicable.

12. Cost of time of workers whose work was affected due to the damage to the machinery equipment or the injured worker's absence.

Not Applicable.

13. a. Cost of time lost by the workers by talking, watching, helping

6 workers.

Time lost per worker 1 hour 15 min.

b. time lost by the people who carried the injured to the ward

Total time lost = 6:30 + (6 x 1:15) + (2 x 1) = 16 Hours

Average pay per hour 8 TL/hr Cost

Cost = 16 x 8 = 128 TL

14. Cost of time spend for the accident by the supervisor.

2 hrs 30 min

Average pay/hr 10 TL/hr Cost 20 TL

Cost = 2.5 x 20 = 50 TL

15. Cost of reduced production of the worker after the accident, in terms of pay.

Not Applicable.

16. If a new worker is recruited to replace the injured worker, the cost of training period in terms of pay.

a. the number of days where the new worker's production was below the average.

Not Applicable.

b. During this time, the how much below the average was his production?

Not Applicable.

c. time spent by the supervisor or others for training this worker

Not Applicable.

17.Medical and other expenses by the company outside the expenses made by the Insurance.

Referred to hospital 20 km away from the mine. Over time paid to the driver, fuel expense, allowance.

Fuel: 10 TL
Driver: 2 hour x 8 TL/hour = 16
Accompanied by two people: 2 x 2 x 8 = 32 TL

Cost = 58 TL

18.The cost of time spent for the investigation of the accident and for procedures. 2 days/engineer, paper work, typing, electricity communication

2 days/engineer = 2 x 7.5 x 10 = 150 TL
Paper work, typing, electricity communication etc. = 50 TL
Cost = 200 TL

19.Other costs in detail not included here (sales loss due to the accident, advertisement for recruiting a new employer, cost of the interview, etc).

Total Indirect Cost = 128 + 50 + 58 + 200 = 436 TL.

4.7.2 Case Study II

While working on the face area, a block slipped and squeezed his left foot. After the accident worker was immediately referred to hospital.

Occupational Safety Officer Cost Data Report

1. Name of the Employee: Dursun Demir

2. Job Title: Ordinary Worker (U/G)

3. Section : Ömerler U/G 406

4. Accident Date & Time: 25/03/2006 19:30

5. To Whom He/She Reports: Mining Engineer

6. Is There Injury Yes (X) No ( )

If Yes;

Detail the Accident:

While working on the face area, a block slipped and squeezed his left foot. After the accident worker was immediately referred to hospital.

7. The working time lost by the employee on the day in which accident occurred:

4 Hours, 30 Minutes

8. If the production stops for a given period of time, was it necessary to work overtime to fulfill the production loss?

Yes (X) No ( )

a. How many hours? 1 Hours

b. How many employees? 3

c. Amount of production loss: 3/7.5 x 5 = 2 Tons

9. Explain the damage on the equipments and materials.

Not Applicable

10. How many employees stopped work by the damaged equipments or injured person/persons?

Not Applicable

11. During the accident period, how many employees lost time by talking, watching the accident and/or by helping the injured person/persons?

2 Employees

Time Lost: 6 Hrs, 30 Minutes.

12. How many hours and minutes did the supervisor lost by helping the injured person/s, investigating, writing report, reordering jobs, training the new employee to be worked instead of injured person?

Not Applicable

13. How many hours and minutes did the supervisor lost by helping the injured person/s, investigating, writing report, reordering jobs, training the new employee to be worked instead of injured person?

2 Hrs, ____________Minutes.

14. How and by whom was the injured person taken from the place that the accident occurred to the first aid station?

With the help of 3 workers.

The injured worker was carried away by means of two people and was taken to hospital.

Accident Cost Report

1. Name of the Employee:	Dursun Demir
2. Job Title Worker:	(U/G)
3. Section Ömerler:	U/G 406
4. Accident Data & Time:	25/03/2006 19:30
5. To whom He/She Reports:	Mining Engineer
6. Wage Per Hour:	8 TL/hour

7. Did the Accident;

Cause the time lost?	Yes (X)	No ( )
Cause to doctor's care?	Yes (X)	No ( )
Cause only to first aid ?	Yes ( )	No (X)

If an injury took place, detail the accident.

While working on the face area, a block slipped and squeezed his left foot. After the accident worker was immediately referred to hospital.

8. Except in the disability payment example, the cost of working time lost in terms of pay during the time period the injured worker is paid.

a Working time lost during the days of the accident when the worker was fully paid.

4 Hours 30 Minutes

b. Number of days the worker was paid following the accident.

45 days, 7.5 hr/per day, Total 337.5 hrs

Cost: (337.5 + 4.5) *8 = 3536 TL

9. Was the work which the injured worker had to be completed by overtime after the accident?

Not Applicable.

10. Lost of overtime to overcome production loss.

Not Applicable.

11. The type of damage in the machinery and equipment.

Not Applicable.

12. Cost of time of workers whose work was affected due to the damage to the machinery equipment or the injured worker's absence.

Not Applicable.

13. a. Cost of time lost by the workers by talking, watching, helping :

3 workers.

time lost per worker 1 hr 30 min.

c. time lost by the people who carried the injured to the ward

3 hrs 30 min

total time lost 5hr ________ Minutes

Average pay per hour 7 TL/hr

Cost 35 TL

14. Cost of time spend for the accident by the supervisor.

2 hrs 30 Minutes

Average pay/hr 10 TL/hr

Cost 25 TL

15 Cost of reduced production of the worker after the accident, in terms of pay.

a. period spend in light or low production

days 7.5 hrs.

Cost: [(3/7.5)days * 5 ton/day * 30 TL/ton] = 60 TL

16. If a new worker is recruited to replace the injured worker, the cost of training period in terms of pay.

Not Applicable.

17. Medical and other expenses by the company outside the expenses made by the Insurance.

Referred to hospital 20 km away from the mine. Over time paid to the driver, fuel expense, allowance.

Fuel: 10 TL

Driver: 2 hour x 8 TL/hour = 16

Accompanied by two people: 2 x 2 x 8 = 32 TL

Cost = 58 TL

18 The cost of time spent for the investigation of the accident and for procedures. 2 days/engineer, paper work, typing, electricity communication

2 days/engineer = 2 x 7.5 x 10 = 150 TL

Paper work, typing, electricity communication etc. = 50 TL

Cost = 200 TL

19 The costs in detail not included here (sales loss due to the accident, advertisement for recruiting a new employer, cost of the interview, etc).

Total Indirect Cost = 3536 + 35 + 25 + 60+ 58 + 200 =3914 TL.

CHAPTER 5.

EVALUATION OF THE RESULTS AND DISCUSSION

A statistical analysis of occupational accidents which occurred in GLI Coal Mine in the years 2005 and 2006 gives the following results: 22.4% of the accidents were of machinery type, and 20.1% were due to falling, rolling or sliding rocks. Considering occurrence of months and days, 12.7% of the accidents occurred in December, and 19.4% occurred on Mondays. In terms of part of body injured, 34.3% of the accidents caused injuries on feet, 26.1% on hands and fingers, and 15.7% on the head. When we look at occurrence times, 63.4% of the accidents occurred in Shift 2 (08:00 – 16:00). Accidents densely occurred in the time interval of 08:00 – 14:00 (53.7%). Workers were subject to 18.7% of the accidents, and coal winners were subject to 15.7% of the accidents. Workers between 40-49 were subject to a big percent of the accidents, 40-44 age group of workers were subject to 41.8%, and 44-49 age group were subject to 38.8% of the accidents. 33.6% of the accidents happened in the face area. Underground accidents comprised 57% of all accidents, due to the characteristics of the works and work places. Analyzing these results so much information about mine accidents can be obtained. Therefore accidents statistics should be kept regularly and analyzed periodically to achieve to an effective accident prevention strategy.

In our country, the rate of accidents is very high. That is, considering all industry sectors we have 0.96 as ASR and 4.03 as AFR in 2006. Reducing the rate of accidents is important for any mine from both economic and humanitarian aspects.

Due to the occupational accidents happened in 2006, a total of 913,555 work days were lost in coal mining sector. According to the figures of the mine as of 2006, value added and production loss came up to a total of 37,062,926.35 TL for coal mining.

Although a total of direct and indirect costs could not be calculated due to unavailability of data, it may as well be said that the total cost of occupational accidents will be a few times as much as this figure.

The first objective of this study was to analyze the mine accidents. To approach, accident statistics of all industry sector, mining sector, coal sector, Turkish Coal Enterprises, and Western Lignite Enterprises are used. The second objective was to emphasize the economic perspective of the Occupational Health and Safety (OHS). To be successful, economic base of the OHS was given. The overall goal of the study was to conduct cost analysis of the mine accidents and make the costs almost concrete or visible.

In this study the two important elements involved in the application of modern accident preventing technique were investigated: Accident analysis and cost analysis of accidents. In this context "Accident Report form" was prepared, statistical analysis was conducted. Cost calculations were done by considering two actual cases in mines.

In this study "Mine Accident Report Form" was prepared to standardize the accident data. In order to analyze mine accidents, injury data, it is important to obtain adequate information. It is also required to evaluate and develop mine safety and health standards and programs which benefit the industry. Identifying the measures for the reduction of the accidents to the minimum can only be possible by means of keeping a record of accident analyses and reviewing them in certain periods of time. The prerequisite for the expanding of statistical analysis country-wide is to ensure the employment of a standard accident form in all mines. This will enable the statistical assessment or classification of the accidents throughout the country. Therefore such a form should be prepared and put into service immediately.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

Health has an intrinsic value for a person. Health is also a valuable asset as a source of a productive life and as a source of more time for a productive life. More time means extended lifespan and can help lead people to postpone retirement. Improved health and a longer work career can also be promoted if disabilities and the death rates of common lifestyle-related diseases, such as heart disease, decrease.

A healthy worker is less absent from work stays at work longer, retires later, and has fewer sick leaves. Good OHS may help to keep workers in a company and may also produce benefits, such as higher productivity and better recruitment. As human resource experts often cite, workers' well-being at work, adaptations to disabilities and return to work arrangements after illnesses are part of the investment in the human capital of the company.

In addition to unnecessary human suffering, the costs involved in these health hazards have been estimated to amount up to several percent of some countries' gross national product (GNP).

Türkiye's high rates of work-related fatal and non-fatal injury present a significant challenge to us all. Every year significant numbers of people die and many more are severely affected by work-related injuries and disease.

In this study the importance of statistical analyses was emphasized and its importance on accident preventing programs was illustrated as case studies by using accident data available in GLİ Coal Mine. The purpose of these case studies is to help to conduct statistical analysis. A statistics of occupational accidents which occurred in GLI Coal Mine in the years 2005 and 2006 given in Appendixes 2 and 3.

Despite an improving record of progress in reducing mining fatalities and injuries through management commitment to safety, education/training, technological advances in safety equipment, the application of best practices, and compliance with mandated regulation, accidental losses are still unacceptable. Mine accidents continue to represent an area requiring attention and increased prevention efforts. Even experienced workers appear to be vulnerable to mishaps because of their excessive self confidence and they should therefore be at the center of intervention strategies for this category. A focused, comprehensive program of safety needs to be considered by both surface and underground mining operations. Significant resources need to be budgeted toward prevention methods that address all aspects of safety, i.e., the person, the behavior, and the equipment.

The direct and indirect costs of occupational accidents have impact on the employees, on the mine and on the national economy as well. The management of the mine should monitor cost of the accidents by means of using suitable computer software. Besides, when the cost of occupational accidents is calculated, the management will be able to compare this figure with the cost of accident preventing program. Other important element of accident preventing program is the cost of accidents. As a result cost analysis of mine accidents will serve to accelerate and expand the efforts of industry, government and coal miners to work toward safer extraction of coal. Effective legal adjustments should be made in order to monitor the cost of job accidents in the mine. And then, the cost data obtained from all of the mines should be evaluated by a centre in order to show the cost of the accidents of the industry.

Mine safety is an attitude of mind. It may not be effectively legislated. It requires a safety conscious worker and a safe working environment. The first is a matter of education and training. Increasing degrees of skill are being required for the more technologically developed and equipped mines and it is the mine operator's responsibility to adequately equip his workforce both physically and mentally. It is likewise the mine operator's responsibility to provide a safe working environment and standards; legislation and guideline provide some guidance on how this can be achieved. Bu still it is the responsibility of each individual mineworker to perform his duties in a safe manner, not only to ensure his own safety but also that of his workmates. Only by the application of safe working principles to all aspects of mining operations can some inroads be made into the devastating societal toll of mine accidents.

Because it is apparent that questions of accident prevention can be solved not in isolation, but only in the context of their relationship with production and the working environment, the following principles for accident prevention can be derived for the employers:

- Accident prevention must be built into production planning with the goal of avoiding disruptions.
- The ultimate goal must be to achieve a production flow that is as unhindered as possible. This results not only in reliability and the elimination of defects, but also in the workers' well-being, labour-saving methods and job safety.

Some of the practices commonly used in the workplace to achieve job safety and which are necessary for disruption-free production include, but are not limited to the following:

- Workers and supervisors must be informed and aware of the dangers and potential hazards (e.g., through education).
- Workers must be motivated to function safely (behavior modification).
- Workers must be able to function safely. This is accomplished through certification procedures, training and education.
- The personal working environment should be safe and healthy through the use of administrative or engineering controls, substitution of less hazardous materials or conditions, or by the use of personal protective equipment.
- Equipment, machinery and objects must function safely for their intended use, with operating controls designed to human capabilities.
- Provisions should be made for appropriate emergency response in order to limit the consequences of accidents, incidents and injuries.

OHS improvement also ultimately depends on government policies. Governments, in their capacity as major employers, policy makers, regulators and procurers, have considerable influence over the achievement of better OHS outcomes. For this purpose governments must develop effective legislative framework and must follow the compliances of the applications in all industrial sectors specifically the mining sector.

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APPENDIX 1

ACCIDENT REPORT FORM AND ACCIDENT COST REPORT FORM

Occupational Safety Officer Cost Data Report

1. Name of the Employee:
2. Job Title:
3. Section :
4. Accident Date & Time:
5. To Whom He/She Reports:
6. Is There Injury Yes ( ) No ( )

If Yes;

Detail the Accident:

7. The working time lost by the employee on the day in which accident occurred:

Hours, Minutes

8. If the production stops for a given period of time, was it necessary to work overtime to fulfill the production loss?

Yes ( ) No ( )

a. How many hours? _____________ _ Hours ___________ Minutes

b. How many employees?

c. Amount of production loss: _ Tons

9. Explain the damage on the equipments and materials.

10. How many employees stopped work by the damaged equipments or injured person/persons?

Employees

The time lost per one employee _____ Hrs, ________ Mins.

11. During the accident period, how many employees lost time by talking, watching the accident and/or by helping the injured person/persons?

Employees

Time Lost: Hrs, ___________ Mins.

12. How many hours and minutes did the supervisor lost by helping the injured person/s, investigating, writing report, reordering jobs, training the new employee to be worked instead of injured person?

Hrs, ____________Mins.

13. How and by whom was the injured person taken from the place that the accident occurred to the first aid station?

SUPERVISOR'S NAME

SIGN

Accident Cost Report

1. Name of the Employee:

2. Job Title:

3. Section:

4. Accident Data & Time:

5. To whom He/She Reports:

6. Wage Per Hour:

7. Did the Accident:

Cause the time lost?	Yes ( )	No ( )
Cause to doctor's care?	Yes ( )	No (...)
Cause only to first aid ?	Yes ( )	No ( )

If an injury took place, detail the accident.

8. Except in the disability payment example, the cost of working time lost in terms of pay during the time period the injured worker is paid.

a. Working time lost during the days of the accident when the worker was fully paid.

Hours Minutes

b. Number of days the worker was paid following the accident.

Days, _____________ hour/per day, total _________________ hours

c. Number of visits to the hospital for medical examination after starting work

_____ Duration of each visit _____ hours, minutes.

Total duration _____ hours, ___ minutes.

d Outside these, the period spent was paid but was not working.

Hours Minutes

Cost: total time, wage per hr : ________

9. Was the work which the injured worker had to be completed by overtime after the accident?

(Overtime pay, transportation, supervisor and other items of cost)
_____ TL

10. Lost of overtime to overcome production loss.

___ persons ___________ hours ____ average pay/hour

_______ TL cost.

Amount of production loss _____ tones _________ TL/tone

_______ TL cost.

11. The type of damage in the machinery and equipment.

Maintenance, repair and/or renewal cost
_____ TL.

12. Cost of time of workers whose work was affected due to the damage to the machinery equipment or the injured worker's absence.

_____workers

time lost per worker ___hours

total loss ___hours

Average pay per hour __ TL/hour

Cost ________TL

13. a. Cost of time lost by the workers by talking, watching, helping

______workers

time lost per worker hours ______ minutes.

b.time lost by the people who carried the injured to the ward

hours minutes

Total time lost hours _____ minutes

Average pay per hour: TL/ hour Cost

14. Cost of time spend for the accident by the supervisor.

hours _______minutes

Average pay/ hours

15. Cost of reduced production of the worker after the accident, in terms of pay.

a. period spend in light or low production

___ days _____________hours.

Cost ______________TL

b.the percentage of the loss of production of the worker In the overall production.

% Cost TL

16. If a new worker is recruited to replace the injured worker, the cost of training period in terms of pay.

a. the number of days where the new worker's production was below the average.

______days

b. During this time, the how much below the average was his production?

%

pay/hr _________ TL/ hour

Cost __________TL

c. time spent by the supervisor or others for training this worker

hours ___________________ TL/ hour

Cost ____________ TL

17. Medical and other expenses by the company outside the expenses made by the Insurance.

Fuel

driver + over time + allowance

Total

18. The cost of time spent for the investigation of the accident and for procedures.

days/engineer, paper work, typing, electricity communication

19. Other costs in detail not included here (sales loss due to the accident, advertisement for recruiting a new employer, cost of the interview, etc).

____ TL.

Total Indirect Cost:

____ TL.

APPENDIX 2

A2.1 TABLE 6.1 ACCIDENT DATA OF GLI FOR THE YEAR OF 2006

NAME	AGE	ACCIDENT DATE	TIME	DAY	MONTH	JOB TITLE	PLACE	ACCIDENT TYPE	PART OF BODY INJURED	DAYS LOST
Y. Korku	42	03/01/2006	11:00	Tuesday	January	1	1	1	6	5
H. Kara	46	04/01/2006	01:55	Wednesday	January	2	2	9	1	6
R.Sayan	44	25/01/2006	06:10	Wednesday	January	5	1	1	3	5
M. Çetin	49	24/02/2006	11:00	Friday	February	16	5	1	3	59
C. Uzun	48	08/03/2006	09:30	Wednesday	March	10	4	2	3	3
A. Manisalı	40	13/03/2006	03:40	Monday	March	4	3	9	3	64
Y. Çağlar	40	17/03/2006	17:50	Friday	March	1	1	3	3	60
D. Demir	41	25/03/2006	19:30	Saturday	March	1	1	3	3	45
A.Şahin	47	31/03/2006	14:30	Friday	March	1	1	3	2	7
N. Korkmaz	40	07/04/2006	11:00	Friday	April	1	1	1	6	9
M. Solmaz	47	10/04/2006	17:30	Monday	April	11	8	7	6	7500
R.Yavaştürk	47	15/04/2006	11:00	Saturday	April	15	4	8	2	66
H.H.Göde	42	20/04/2006	13:00	Thursday	April	1	1	1	6	15
M. Coşkun	43	25/04/2006	04:30	Tuesday	April	1	1	8	2	7
İ. Delibaş	46	26/04/2006	11:10	Wednesday	April	15	8	5	2	7
H. Güneş	48	27/04/2006	20:00	Thursday	April	2	3	1	2	5
C. Karakulluk	46	16/05/2006	10:30	Tuesday	May	1	3	4	2	3
S. Yüce	48	22/05/2006	10:50	Monday	May	7	3	1	3	10
M. Akarsu	42	23/05/2006	04:30	Tuesday	May	2	1	3	4	10
K. Tuncel	46	30/05/2006	12:15	Tuesday	May	2	1	6	3	7
S. Günay	46	15/06/2006	09:00	Thursday	June	12	5	4	2	19
B. Balta	37	22/06/2006	11:15	Thursday	June	15	8	4	6	3
S. Şafak	41	29/06/2006	11:45	Thursday	June	15	5	8	1	6
İ. Kale	36	10/07/2006	13:40	Monday	July	15	5	1	7	5
R. Özbey	44	20/07/2006	09:20	Thursday	July	14	8	8	3	18
Y. Tanrıver	42	14/08/2006	10:00	Monday	August	1	2	4	2	19
Y. Ilgın	44	02/09/2006	10:00	Saturday	September	9	3	5	5	15
S. Gökçe	43	19/09/2006	02:30	Tuesday	September	1	1	9	1	4
H. Kaya	40	20/09/2006	09:20	Wednesday	September	1	1	2	3	10
H. Şen	45	26/09/2006	13:30	Tuesday	September	2	1	1	6	5
İ. Akkaya	40	27/09/2006	01:10	Wednesday	September	2	1	2	7	11
M. Kırşan	40	04/10/2006	20:39	Wednesday	October	6	2	9	6	19
M. Arslan	46	12/10/2006	11:50	Thursday	October	2	1	6	1	6
S. Yoldaş	44	12/10/2006	11:30	Thursday	October	1	8	8	3	22
S.Yeşilyurt	41	13/10/2006	11:15	Friday	October	1	1	1	2	43
S. Kuru	46	31/10/2006	06:30	Tuesday	October	1	1	1	2	11
M. Türker	45	04/11/2006	10:00	Saturday	November	10	8	8	3	7
M. Öztan	41	07/11/2006	09:30	Tuesday	November	4	2	4	2	5
M. Çelik	43	20/11/2006	12:05	Monday	November	1	1	2	6	6
T. Pekpak	47	20/11/2006	14:00	Monday	November	14	8	8	3	3

APPENDIX 2

A2.1 TABLE 6.1 ACCIDENT DATA OF GLI FOR THE YEAR OF 2006 (CONTINUED)

NAME	AGE	ACCIDENT DATE	TIME	DAY	MONTH	JOB TITLE	PLACE	ACCIDENT TYPE	PART OF BODY INJURED	DAYS LOST
İ. Yardımcı	44	29/11/2006	10:30	Wednesday	November	10	4	1	1	21
F. Muslu	40	04/12/2006	20:15	Monday	December	1	1	5	2	5
N.Demir	49	11/12/2006	11:00	Monday	December	15	4	8	1	1
T.Pehlivan	44	11/12/2006	11:00	Monday	December	15	4	8	3	3
İ. Şen	51	12/12/2006	13:30	Tuesday	December	14	7	8	4	7
G. Gürbüz	42	14/12/2006	19:30	Thursday	December	1	1	6	2	44
H. Şen	45	25/12/2006	02:30	Monday	December	2	1	2	3	10
R. Karabulu	51	25/12/2006	02:30	Monday	December	2	1	2	3	10
H. Zeybek	50	30/12/2006	22:45	Saturday	December	14	5	8	2	20

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A3.1 TABLE 6.2 ACCIDENT DATA OF GLI FOR THE YEAR OF 2005

NAME	AGE	ACCIDENT DATE	DAY	MONTH	TIME	JOB TITLE	PLACE	ACCIDENT TYPI	PART OF BODY INJURED	DAYS LOST
H. Uslu	47	02.05.2005	Monday	May	18:00	1	1	2	2	26
D. Kabakcı	44	10.09.2005	Saturday	September	10:15	1	1	9	1	41
Ö. Memiş	46	18.04.2005	Monday	April	09:50	2	1	2	2	9
Ş. Zeyrek	45	08.09.2005	Thursday	September	03:20	2	1	2	7	30
A. Sayar	49	04.09.2005	Sunday	September	21:20	2	1	2	3	19
Ö. Salcı	48	15.01.2005	Saturday	January	17:00	2	1	3	2	175
V. Büyük	41	17.10.2005	Monday	October	12:20	2	1	3	3	10
K. Kara	43	18.11.2005	Friday	November	19:30	2	1	3	3	5
Y. Ülgen	39	01.06.2005	Wednesday	June	12:00	2	1	8	6	10
N. Karataş	45	10.09.2005	Saturday	September	18:00	3	1	2	6	20
E.Karabacak	39	13.10.2005	Thursday	October	12:30	4	1	1	4	10
R. Çanakçı	38	04.10.2005	Tuesday	October	19:20	4	1	3	3	9
Ş. Gürgün	39	18.06.2005	Saturday	June	06:30	4	1	4	3	91
A. Arslan	47	06.12.2005	Tuesday	December	03:30	4	1	6	1	5
O. Eren	44	06.06.2005	Monday	June	06:00	4	1	8	6	19
A. Yalçın	45	23.06.2005	Thursday	June	10:45	4	1	8	1	1
M. Sal	46	14.10.2005	Friday	October	22:15	5	1	1	3	94
M. Dingil	50	31.08.2005	Wednesday	August	09:30	7	1	3	3	36
M. Yıldız	44	09.07.2005	Thursday	July	18:15	8	1	7	2	44
Ş Yılmaz	50	22.04.2005	Friday	April	20:00	8	1	8	1	17
A. Agca	45	01.04.2005	Friday	April	20:15	9	1	2	4	99
O. Öztürk	48	23.08.2005	Tuesday	August	05:45	9	1	2	3	40
H.Kahraman	45	21.09.2005	Wednesday	September	11:45	9	1	9	1	8
E. Çetin	48	10.10.2005	Monday	October	12:20	1	2	3	3	58
N. Korkmaz	39	08.11.2005	Tuesday	November	02:30	1	2	3	2	10
C. Akıncı	39	12.11.2005	Saturday	November	14:30	1	2	3	3	10
M. Çetin	40	11.05.2005	Wednesday	May	12:30	2	2	2	6	6
C. Yavuz	45	22.11.2005	Tuesday	November	18:30	2	2	2	1	15
D. Çakır	39	04.05.2005	Wednesday	May	04:30	3	2	2	2	141
N.Gürcan	49	22.02.2005	Tuesday	February	11:00	5	2	8	2	3
A. Karlı	49	25.02.2005	Friday	February	19:30	6	2	2	3	110
M. Coşkun	42	28.07.2005	Thursday	July	08:00	1	3	1	2	15
N. Korkmaz	39	22.07.2005	Friday	July	18:30	1	3	1	3	9
H. Çelik	48	10.10.2005	Monday	October	11:00	1	3	8	2	6
D. Güner	50	09.11.2005	Wednesday	November	10:25	2	3	2	1	9
S. Parlak	40	31.08.2005	Wednesday	August	18:30	2	3	2	3	15
R. Gökdal	55	29.11.2005	Tuesday	November	22:00	2	3	9	3	5

A3.1 TABLE 6.2 ACCIDENT DATA OF GLI FOR THE YEAR OF 2005 (CONTINUED)

NAME	AGE	ACCIDENT DATE	DAY	MONTH	TIME	JOB TITLE	PLACE	ACCIDENT TYPE	PART OF BODY INJURED	DAYS LOST
İ. Hasdemir	46	22.09.2005	Thursday	September	11:30	4	3	1	2	12
M. Atak	43	02.12.2005	Friday	December	14:50	4	3	2	3	6
A. A. Öztürk	45	10.12.2005	Saturday	December	14:30	5	3	9	2	20
E. Çakır	48	10.10.2005	Monday	October	12:20	6	3	3	3	10
M. Çetin	40	22.07.2005	Friday	July	18:30	6	3	4	7	5
S Malkoç	45	15.07.2005	Friday	July	19:00	8	3	4	2	20
R. Malkoc	44	28.12.2005	Wednesday	December	09:30	9	3	1	3	7
İ.Oymaağaç	43	15.08.2005	Monday	August	06:00	9	3	2	3	10
Gündüz	43	30.11.2005	Wednesday	November	18:00	9	3	4	6	20
E. Gezer	35	05.12.2005	Monday	December	14:45	12	4	1	7	18
İ. Arslan	47	13.12.2005	Tuesday	December	10:30	12	4	2	2	20
H. Aktepe	41	14.10.2005	Friday	October	08:45	12	4	5	2	14
A. Çevik	35	26.05.2005	Thursday	May	13:45	12	4	6	6	7
M. Demir	40	31.08.2005	Wednesday	August	11:15	12	4	8	3	45
İ. Sarı	45	21.02.2005	Monday	February	13:30	12	4	8	1	39
H. Kurt	41	14.08.2005	Sunday	August	09:30	12	4	8	3	148
E. Çetin	40	20.12.2005	Tuesday	December	09:15	15	4	2	1	6
A. Özlü	46	25.05.2005	Wednesday	May	08:30	15	4	2	5	8
M. Efe	44	21.09.2005	Wednesday	September	08:30	15	4	6	1	5
Y. Ertugrul	41	07.05.2005	Saturday	May	12:30	15	4	8	2	10
A. Çetin	47	21.05.2005	Saturday	May	15:35	12	5	1	3	30
N. Dinler	46	02.09.2005	Friday	September	11:30	12	5	2	3	9
H. Karabulut	36	21.04.2005	Thursday	April	10:55	12	5	8	1	46
Y. Polat	41	09.06.2005	Thursday	June	09:15	12	5	9	1	5
R. Korkmaz	49	05.07.2005	Tuesday	July	18:55	16	5	1	3	31
M. Yarım	47	07.02.2005	Wedneday	February	14:30	16	5	1	7	215
M. Kılıç	41	18.03.2005	Friday	March	08:20	10	6	8	6	8
Y. Zeyrek	41	06.05.2005	Friday	May	09:00	10	7	1	1	7
K. Düzgün	46	11.03.2005	Friday	March	10:30	10	7	9	1	81
İ. Bulut	49	28.02.2005	Monday	February	08:45	15	7	4	6	5
Ö.Demirkır	47	11.08.2005	Thursday	August	13:30	15	7	8	1	2
İ. Acet	42	04.05.2005	Wednesday	May	11:00	9	8	4	2	4
H. Tuncer	49	25.02.2005	Friday	February	17:00	10	8	8	2	3
M. Şengül	55	28.03.2005	Monday	March	10:45	16	8	2	4	13
H. Atlı	44	06.09.2005	Tuesday	September	10:30	10	8	1	3	4
A. Tokcan	41	22.07.2005	Friday	July	12:30	10	8	8	2	5
H. Okumuş	42	12.12.2005	Monday	December	10:00	12	8	6	3	20
İ. Yeşil	38	12.07.2005	Tuesday	July	14:15	12	8	7	2	5

A3.1 TABLE 6.2 ACCIDENT DATA OF GLI FOR THE YEAR OF 2005 (CONTINUED)

NAME	AGE	ACCIDENT DATE	DAY	MONTH	TIME	JOB TITLE	PLACE	ACCIDENT TYPI	PART OF BODY INJURED	DAYS LOST
M. Şenol	43	10.01.2005	Monday	January	13:50	12	8	8	3	62
A. Aydın	39	14.05.2005	Saturday	May	15:00	12	8	8	3	38
E. Gültekin	28	18.11.2005	Friday	November	22:00	13	8	3	7	10
K. Saglam	39	27.12.2005	Tuesday	December	00:45	14	8	7	7	20
İ. Çağlı	43	05.07.2005	Tuesday	July	18:00	14	8	8	3	19
H. Gülseren	40	21.10.2005	Friday	October	09:00	14	8	8	6	11
K. Türk	44	21.09.2005	Wednesday	September	14:50	15	8	1	3	97
Z. Gülmezer	41	29.03.2005	Tuesday	March	08:30	15	8	2	2	5
H.Kahraman	45	01.10.2005	Saturday	October	14:13	16	8	3	3	15
H.Kahraman	51	14.07.2005	Thursday	July	14:20	12	8	7	2	5

A 4.1 TABLE 6.3 INCIDANCE RATE (*) AND WEIGHT RATE (**) EMPLOYMENT INJURIES IN 2006

Seasons in 2006	N'of Employm. Injuries	NDPA	Incidence rate of emp. inj. (*)		Dura.of temp. incap. for work (days)	Total degrees of perm. İncap.	N'of death	Weight rate of employment injuries (**)	
			per 1,000,000 work.hours	100 kişide (per 100 person)				Days	Hours
Jan - Feb March - April	21,316	768,342,835	3.47	0.78					
May-June-July-August	25,572	827,792,368	3.86	0.87	-	67,360	-	258	0.21
Sept-Oct-Nov-Dec	32,139	853,735,272	4.71	1.06					
Total	**79,027**	**2,449,870,475**	**4.03**	**0.91**					

(*) Incidence rate of employment injuries

I METHOD : This method represents the number of injuries per 1,000,000 working hours ,

II METHOD : This method represents the number of injuries per 100 full-time workers. Its formula as follows,

Incidence rate of employment inj. = NEI / (NDPA*8) *1,000,000

or =NEI / (NDPA*8)*225,000

where;

NEI= number of employment injuries,

NDPA= number of days of premium accrued represents total days worked by all insured persons during calendar year. (multiplied by 8 hours per day)

1,000,000= base for proportion of number of injuries per 1,000,000 working hours.

225,000= for second way, base for 100 equivalent full time insured person (working 45 hours per week, 50 weeks per year).

(**) Weight Rate of Employment Injuries

I METHOD : This method represents the number of lost workdays per 1,000,000 working hours

II METHOD : This method represents the number of lost hours per 100 working hours because of employment injuries. Its formula as follows,

Weight rate of employment inj. = TLD / (NDPA*8) *1,000,000

or =(TLD*8) / (NDPA*8)*100

where;

TLD= number of total lost working days because of employment injuries, (Duration of temp. İncapacity as day)+(Total degress of perm. İncapacity*75)+(N'of death*7.500)

NDPA= number of days of premium accrued represents total days worked by all insured persons during calendar year. (multiplied by 8 hours per day)

1,000,000= base for proportion of number of total lost workdays per 1,000,000 working hours.

100= for second way, base for proportion of number of total lost hours per 100 working hours.

A 5.1 TABLE 6.4 THE DISTRIBUTION OF THE NUMBER OF EMPLOYMENT INJURIES AND OCCUPATIONAL DISEASES, PERMANENT INCAPACITY TO WORK, DEATH CASES AND STANDART EMPLOYMENT INJURY RATES WHOSE FORMALITIES COMPLETED BY BRANCH OF ACTIVITIES AND GENDER IN 2006

Branch of activites (*)	N'of Employment Injuries			N'of Occupational Diseases			N' of Permanent Incapacity									N'of Death Cases									Standart employment injury rates % (**)
							Employment Injuries			Occupational Diseases			Total			Employment Injuries			Occupational Diseases			Total			
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	
AGRICULTURE AND LIVESTOCK	47	336	**383**	0	0	**0**	1	13	**14**	0	0	**0**	**1**	**13**	**14**	0	11	**11**	0	0	**0**	**0**	**11**	**11**	**73.5**
FORESTY AND LOGGING	1	91	**92**	0	0	**0**	0	6	**6**	0	0	**0**	**0**	**6**	**6**	0	5	**5**	0	0	**0**	**0**	**5**	**5**	**37.7**
FISHING	2	21	**23**	0	0	**0**	0	1	**1**	0	0	**0**	**0**	**1**	**1**	0	0	**0**	0	0	**0**	**0**	**0**	**0**	**55.6**
COAL MINING	6	6,716	**6,722**	0	416	**416**	0	104	**104**	0	285	**285**	**0**	**389**	**389**	0	35	**35**	0	0	**0**	**0**	**35**	**35**	**1,525.90**
NON-COAL MINING	0	239	**239**	0	4	**4**	0	11	**11**	0	4	**4**	**0**	**15**	**15**	0	13	**13**	0	0	**0**	**0**	**13**	**13**	**193**
CRUDE OIL AND NATURAL GAS	0	34	**34**	0	0	**0**	0	4	**4**	0	0	**0**	**0**	**4**	**4**	0	1	**1**	0	0	**0**	**0**	**1**	**1**	**117.5**
STONE QUARRYING CLAY AND SAND	0	479	**479**	0	0	**0**	0	33	**33**	0	0	**0**	**0**	**33**	**33**	0	26	**26**	0	0	**0**	**0**	**26**	**26**	**125.6**
PITS OTHER NON METALIC MATERIAL PRODUCTS	1	150	**151**	0	0	**0**	0	7	**7**	0	0	**0**	**0**	**7**	**7**	0	5	**5**	0	0	**0**	**0**	**5**	**5**	**131.3**
FOOD MANUFACTURING INDUSTRIES	377	2,075	**2,452**	0	0	**0**	9	67	**76**	0	0	**0**	**9**	**67**	**76**	1	38	**39**	0	0	**0**	**1**	**38**	**39**	**80.6**
BEVERAGE INDUSTRY	4	105	**109**	0	0	**0**	0	3	**3**	0	0	**0**	**0**	**3**	**3**	0	1	**1**	0	0	**0**	**0**	**1**	**1**	**105.9**
TOBACCO INDUSTRY	48	107	**155**	0	0	**0**	0	1	**1**	0	0	**0**	**0**	**1**	**1**	0	0	**0**	0	0	**0**	**0**	**0**	**0**	**99.3**
TEXTILE INDUSTRY	827	4,328	**5,155**	0	1	**1**	8	117	**125**	1	1	**2**	**9**	**118**	**127**	0	26	**26**	0	0	**0**	**0**	**26**	**26**	**137.1**
MANUFACTURING OF FOOT-WEAR OTHER WEARING APPARELS AND MADE UP TEXTILE GOODS	517	926	**1,443**	0	1	**1**	3	21	**24**	1	0	**1**	**4**	**21**	**25**	3	7	**10**	0	0	**0**	**3**	**7**	**10**	**35.4**
MANUFACTURE OF WOOD AND CORK	34	1,270	**1,304**	0	0	**0**	0	47	**47**	0	0	**0**	**0**	**47**	**47**	0	7	**7**	0	0	**0**	**0**	**7**	**7**	**239.4**
FURNITURE INDUSTRY	25	1,727	**1,752**	0	0	**0**	1	48	**49**	0	0	**0**	**1**	**48**	**49**	1	3	**4**	0	0	**0**	**1**	**3**	**4**	**179.7**
MANUFACTURE OF PAPER AND PAPER PRODUCTS	30	609	**639**	1	0	**1**	0	11	**11**	0	0	**0**	**0**	**11**	**11**	0	8	**8**	0	0	**0**	**0**	**8**	**8**	**200.7**
PRINTING, PUBLISHING AND ALLIED INDUSTRIES	7	314	**321**	0	0	**0**	0	2	**2**	0	0	**0**	**0**	**2**	**2**	0	0	**0**	0	0	**0**	**0**	**0**	**0**	**46.4**
MANUFACTURING OF LEATHER AND MANUFACTURING OF GOODS FROM LEATHER	8	91	**99**	0	0	**0**	0	10	**10**	0	0	**0**	**0**	**10**	**10**	0	2	**2**	0	0	**0**	**0**	**2**	**2**	**47.4**
RUBBER INDUSTRIES	15	742	**757**	0	2	**2**	0	16	**16**	0	1	**1**	**0**	**17**	**17**	0	0	**0**	0	0	**0**	**0**	**0**	**0**	**250.7**
MEDICINE AND CHEMISTRY INDUSTRY	69	1,060	**1,129**	0	5	**5**	2	22	**24**	0	0	**0**	**2**	**22**	**24**	0	6	**6**	0	0	**0**	**0**	**6**	**6**	**141.6**
MANUFACTURING OF PETROLEAUM AND COAL DERIVATIES	2	83	**85**	0	0	**0**	1	0	**1**	0	0	**0**	**1**	**0**	**1**	0	1	**1**	0	0	**0**	**0**	**1**	**1**	**110.6**
PRODUCTS OBTAINED FROM STONE, CLAY, SAND	213	5,098	**5,311**	0	2	**2**	0	79	**79**	0	1	**1**	**0**	**80**	**80**	0	35	**35**	0	0	**0**	**0**	**35**	**35**	**303.7**

A 5.1 TABLE 6.4 THE DISTRIBUTION OF THE NUMBER OF EMPLOYMENT INJURIES AND OCCUPATIONAL DISEASES, PERMANENT INCAPACITY TO WORK, DEATH CASES AND STANDART EMPLOYMENT INJURY RATES WHOSE FORMALITIES COMPLETED BY BRANCH OF ACTIVITIES AND GENDER IN 2006

Branch of activites (*)	N'of Employment Injuries			N'of Occupational Diseases			N' of Permanent Incapacity									N'of Death Cases									Standart employment injury rates % (**)
							Employment Injuries			Occupational Diseases			Total			Employment Injuries			Occupational Diseases			Total			
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	
BASIC METAL INDUSTRIES	19	5,487	**5,506**	0	3	**3**	0	53	**53**	0	1	**1**	**0**	**54**	**54**	0	19	**19**	0	0	**0**	**0**	**19**	**19**	**653.2**
MANUFACTURING OF METAL PRODUCTS INDUSTRY	135	10,904	**11,039**	0	49	**49**	2	188	**190**	0	6	**6**	**2**	**194**	**196**	0	31	**31**	0	0	**0**	**0**	**31**	**31**	**396.9**
MANUFACTURING AND REP. OF MACHINE	105	5,226	**5,331**	0	31	**31**	2	88	**90**	0	2	**2**	**2**	**90**	**92**	0	25	**25**	0	0	**0**	**0**	**25**	**25**	**249.4**
MANUFACTURING AND REP. OF EL. MAC. AND APPARATUS	154	1,295	**1,449**	0	28	**28**	0	25	**25**	0	1	**1**	**0**	**26**	**26**	0	6	**6**	0	0	**0**	**0**	**6**	**6**	**134.4**
MANUFACTURING OF TRANSPORT EQUIPMENTS AND SUPPLIES	67	5,740	**5,807**	0	19	**19**	2	74	**76**	0	2	**2**	**2**	**76**	**78**	0	23	**23**	0	0	**0**	**0**	**23**	**23**	**211.4**
MISCELLANOUS MANUFACTURING INDUSTRIES	117	1,593	**1,710**	0	3	**3**	3	41	**44**	0	0	**0**	**3**	**41**	**44**	1	7	**8**	0	0	**0**	**1**	**7**	**8**	**139.3**
CONSTRUCTION	44	7,099	**7,143**	1	4	**5**	1	424	**425**	0	3	**3**	**1**	**427**	**428**	0	397	**397**	0	0	**0**	**0**	**397**	**397**	**59.6**
HEATİNG WITH ELECTRIC, GAS AND STEAM	10	393	**403**	0	0	**0**	0	23	**23**	0	0	**0**	**0**	**23**	**23**	0	16	**16**	0	0	**0**	**0**	**16**	**16**	**40.8**
WATER AND SANITARY INSTOLLMENTS	3	670	**673**	0	0	**0**	0	23	**23**	0	0	**0**	**0**	**23**	**23**	0	18	**18**	0	0	**0**	**0**	**18**	**18**	**70.5**
WHOLESALE AND RETAIL TRADE	230	2,380	**2,610**	1	0	**1**	7	77	**84**	0	0	**0**	**7**	**77**	**84**	1	69	**70**	0	0	**0**	**1**	**69**	**70**	**25.5**
BANKING	0	28	**28**	0	0	**0**	0	0	**0**	0	0	**0**	**0**	**0**	**0**	0	2	**2**	0	0	**0**	**0**	**2**	**2**	**3.8**
INSURANCE	0	12	**12**	0	0	**0**	0	0	**0**	0	0	**0**	**0**	**0**	**0**	0	0	**0**	0	0	**0**	**0**	**0**	**0**	**3.6**
REALESTATE WORKS (SERVICES)	0	14	**14**	0	0	**0**	0	1	**1**	0	0	**0**	**0**	**1**	**1**	0	0	**0**	0	0	**0**	**0**	**0**	**0**	**13.4**
TRANSPORTATION	151	4,327	**4,478**	0	1	**1**	6	124	**130**	0	0	**0**	**6**	**124**	**130**	0	165	**165**	0	0	**0**	**0**	**165**	**165**	**85.2**
STORAGE AND WAREHOUSİNG	31	288	**319**	0	0	**0**	0	7	**7**	0	0	**0**	**0**	**7**	**7**	0	3	**3**	0	0	**0**	**0**	**3**	**3**	**74.5**
COMMUNICATION SERVICES	0	14	**14**	0	0	**0**	0	1	**1**	0	0	**0**	**0**	**1**	**1**	0	0	**0**	0	0	**0**	**0**	**0**	**0**	**13.2**
GOVERNMENT SERVICES	11	229	**240**	0	0	**0**	0	4	**4**	0	0	**0**	**0**	**4**	**4**	0	4	**4**	0	0	**0**	**0**	**4**	**4**	**21.8**
PUBLIC SERVICES	56	219	**275**	0	1	**1**	2	9	**11**	0	0	**0**	**2**	**9**	**11**	2	8	**10**	0	0	**0**	**2**	**8**	**10**	**6.7**
LEGAL ,COMMERCİAL AND TECHNİCAL SERVİCES	52	766	**818**	0	0	**0**	1	33	**34**	0	2	**2**	**1**	**35**	**36**	0	25	**25**	0	0	**0**	**0**	**25**	**25**	**14.7**
ENTERTAINMENT SERVICES	5	46	**51**	0	0	**0**	0	3	**3**	0	0	**0**	**0**	**3**	**3**	0	3	**3**	0	0	**0**	**0**	**3**	**3**	**9.4**
PERSONAL SERVICES	315	1,936	**2,251**	0	1	**1**	3	55	**58**	0	0	**0**	**3**	**55**	**58**	0	32	**32**	0	0	**0**	**0**	**32**	**32**	**31.7**
UNKNOWN	1	21	**22**	0	0	**0**	1	22	**23**	0	3	**3**	**1**	**25**	**26**	5	495	**500**	0	9	**9**	**5**	**504**	**509**	**0**
TOTAL	**3,739**	**75,288**	**79,027**	**3**	**571**	**574**	**52**	**1,769**	**1,821**	**2**	**312**	**314**	**57**	**2,210**	**2,267**	**14**	**1,578**	**1,592**	**0**	**9**	**9**	**14**	**1,587**	**1,601**	**100**

(**)

Standart employment injury rates (%) = $\frac{\text{Number of employment injuries in the branch of activities in 2006} * 100}{\text{Expected number of employment injury}}$

Expected number of employment injury= (General employment injury speed) * (N'of insured in the branch of activities)

General employment injury speed= $\frac{\text{Total number of employment injury}}{\text{Total number of insured}}$

Source: 2006 Annual Statistics Report of Social Insurance Institution Data.

A 6.1 TABLE 6.5 ACCIDENT STATISTICS OF TKİ FOR 2006

ACCIDENT TYPE	GLİ						ELİ						SLİ		GELİ		Gen.D		TOTAL					
	Underground		Surface		Total		Underground		Surface		Total		Surface		Surface		Surface		Underground		Surface		Total	
	Fat.	Injury	Fat.	Injury	Fat.	Injury	Fat.	Injury	Fat.	Injury	Fat.	Injury	Fat.	Injury	Fat.	Injury	Fat.	Injury	Fat.	Injury	Fat.	Injury	Fat.	Injury
Suffocating, poisoning																								
Ignition or Explosion of Gas or Dust																								
Fall of Roof, Back, or Brow		4				4														4				4
Fall of Material				1		6		1		1		2								6		2		8
Striking of Material		7				7														7				7
Explosives																								
Handling Material		3		2		5		3		10		13		12		3				6		27		33
Mechanical Taransportation								5				5								5				5
Roadway Transportation										1		1				3						7		7
Electricity																2						2		2
Machinery		1		5		6		1		10		11		3		9				2		27		29
Vehicles			1	5	1	5				36		36		8		13					1	62	1	62
Hand Tools				1		3		2		7		9		3		3				4		14		18
Other		9		4		13		3		15		18	1	2		5		1		12	1	27	1	39
2006 Total		31	1	18	1	49		15		80		95	1	31		38		1		46	2	168	2	214
2005 Total		46		39		85		80		101	1	181	3	35		50				126	4	225	4	351
Difference		-15	1	-21	1	-36		-65		-21		-86	-2	-4		-12		1		-80	-2	-57	-2	-137
Mumber of Worker	590		2120		2710		0		3151		3151		1419		1443		185		590		8318		8908	
Number of Days Worked	158663		564864		723527		0		758763		758763		382012		482660		53132		158663		2241431		2400094	
Number of Hours Worked	1269304		4518912		5788216		0		6070104		6070104		3056096		3861280		425056		1269304		17931448		19200752	
Lost Day	503		7739		8242		318		1497		1815		7754		852		45		821		17887		18708	
AFR	0.40		1.71		1.42		*		0.25		0.30		2.54		0.22		0.11		0.65		1.00		0.97	
ASR	24		4		8		*		13		16		10		10		2		36		9		11	

*: NO DATA AVAILABLE

SPACED CELLS HAVE THE VALUE OF ZERO

APPENDIX 7

CODE KEY TO THE GLİ ACCIDENT DATA

CODES FOR PART OF BODY INJURED

PART OF BODY	CODE
Head	1
Hand and Finger	2
Foot	3
Leg	4
Arms	5
Body	6
Various	7

CODES FOR JOB TITLES

JOB TITLE	CODE
Ordinary Worker (U/G)	1
Coal Winner	2
Scalingman	3
Repairman	4
Fitter (mech. & electric)	5
Development Worker	6
Foreman	7
Conveyorman	8
Other(U/G)	9
Ordinary Worker (Surface)	10
Maneuverer	11
Repairman (Surface)	12
Driver	13
Operator	14
Auxiliary Works	15
Other (Surface)	16

APPENDIX 7

CODE KEY TO THE GLİ ACCIDENT DATA

CODES FOR ACCIDENT PLACES

PLACE	CODE
Face Area	1
Developments	2
Roadways	3
Workshops	4
Coal Preperation Facilities	5
Warehouses	6
Social Facilities	7
O/P Mining Area	8

CODES FOR ACCIDENT TYPE

ACCIDENT TYPE	CODE
Entrapment	1
Falling, Rolling, or Sliding Rock or Material of Any Kind	2
Fall of Roof, Back, or Brow/Highwall	3
Handling Material	4
Hand tools	5
Non-powered Haulage	6
Powered Haulage	7
Machinery	8
Other	9