A CONSTRUCTIVE ANALYSIS OF SAFETY CONTROL MECHANISMS AND PRODUCTION COSTS AT A COAL MINE

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DECLARTION

This work has not previously been accepted in substance for any degree at any university and is not concurrently submitted for any degree.

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This dissertation is being submitted in partial fulfilment of the requirements for the degree of Magister Technologiae: Cost and Management Accounting.

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The dissertation is the result of my own independent work/investigation, except where otherwise stated. Other sources are acknowledged by giving explicit references. A bibliography is appended.

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I hereby give consent for my dissertation, if accepted, to be available for photocopying and for interlibrary loan, and for the title and summary to be made available to outside organisations.

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ACKNOWLEDGEMENTS

I would like to thank God for the strength, ability and endurance to complete this dissertation. I also wish to express my gratitude to the following people:

- My supervisor Prof. Merwe Oberholzer, I am eternally grateful to you for your guidance throughout the process of completing this dissertation. I will always admire your commitment and the precision in which you do your work. I could not have asked for a better supervisor. You are the best.

- My Co-supervisor Dr. Deidre Joubert, thank you for believing in me when I did not believe in myself. Thank you for your support and encouragement when I was at my lowest and demotivated, I appreciate it.

- Prof. Manilall Dhurup, I could not have done this without you. You are the reason I am here today. I cannot thank you enough.

- My mother ‘Makesela Leatitia Phohlo and my husband Thabang Stephen Mokoena for their love, support and encouragement.

- The Financial Manager at the Colliery, this would not have been possible without you. Thank you for assisting me and always making time and accommodating me in your busy schedule.

- Ms. Aldine Oosthuyzen (Norht-West University), thank you for your guidance with the questionnaire and statistical support.

Abstract

Statistics in South Africa show that the fatality and injury rates within the mining industry have dropped since the end of the apartheid era. Regardless of the drop the fact remains that the mine workers, who are often the breadwinners, are still dying in the country's mines leaving their families behind without any source of income. If they do not die they may suffer crippling injuries due to mine accidents making it impossible for them to perform their daily duties at work which results in the loss of income, loss of quality of life and this produces a humanitarian and a socio-economic problem. Mining companies incur enormous costs due to fatalities and injuries. Hence a target for zero fatalities was set in the mining industry for 2013. However, the industry has failed to reach this target that it set for itself and it is therefore of the utmost importance to encourage mining companies to invest more than they do currently in safety in order to prevent these fatal and crippling injuries due to mine accidents.

The purpose of this study was to determine whether or not the requirements of safety legislation are observed and complied with by a single Colliery in South Africa that was selected for this study. The study also sought to investigate whether or not the employees of this mine observe the safety regulations to ensure safety and to maintain an accident free working environment. An analysis of organizational safety control mechanisms and production cost was conducted through the use of a structured questionnaire, completed by 151 participants. Descriptive statistics, frequency tables, exploratory factor analysis (EFA), one-way analysis of variance (ANOVA) and t-test were utilized to analyse the data.

The results indicate that the Colliery was compliant with the safety legislations, a positive employee safety attitude had been cultivated and there was provision of adequate safety facilities through safety investments. Cost reduction due to the application of safety controls was also established, yet it was found necessary for the Colliery to enforce and encourage the application of safety measures to reduce the costs that are still incurred as it is evident that the application of safety controls results in reduced costs.

Although the Colliery was considered compliant, with its employees showing a positive attitude towards safety controls, and with safety investments made and cost reduction achieved due to safety measures, ANOVA revealed different perceptions based on the departments in which the employees work, years of experience, English proficiency and qualifications. However, no differences were found in relation to gender and designation.

KEY WORDS: safety, safety controls, production, production costs, colliery, mine

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CHAPTER 1

INTRODUCTION

1.1. INTRODUCTION AND BACKGROUND OF STUDY

In the course of meeting customer demands and managing volatile daily business operations, safety controls which ensure the protection of employees are often overlooked by many organisations. Safety controls are the methods, means, procedures or standards that must be put into place to ensure the safety of employees. Safety is thus the protection from harm or danger. Safety control entails the protection of employees at work from danger, especially in the mines. It can be achieved through occupational safety which is the elimination of conditions that may pose danger to the health and safety of employees in the workplace (Noe, Hollenbeck, Gerhart & Wright 2006:122). The hazardous nature of mining can result in a large number of miners being exposed to injury or death in the mines which creates a negative effect on the financial performance of mining companies, as costs are incurred (Fernandez-Muniz, Montes-Peon & Vanzquez-Ordas 2009:980). These costs include cash and disability benefits, as well as medical expenses for the injured employees and damage to property. The costs that are incurred due to accidents increase the production cost and therefore this results in a decrease in profitability (Ural & Demirkol 2008:1016-1017).

Cloete and Marimuthu (2008:113) define cost as a resource given up in order to realize a specific objective. Van Rensburg, Evangelou, Ziemerink, Govender, Ambe and Koortzen (2007:17) noted that production (manufacturing) cost is the combination of three elements: direct material, direct labour and manufacturing overheads. Direct labour as defined by Cloete and Marimuthu (2008:114) is the cost incurred in the conversion of raw material into finished goods while direct material is the main ingredient of the product. Production overheads (indirect costs) are cumulative costs incurred during production, but cannot be directly attributed to complete products. Examples of production overheads are repairs, depreciation and maintenance. Mining companies also incur these costs in the normal operations of the business. The hazardous nature of mining also imposes additional costs as mines are required by law to have safety regulations and standards in place to ensure the safety of employees. The past studies like Conaway (1972:101) acknowledge that the costs of meeting the safety standards are enormous as the cost of producing coal increased significantly after implementation.

It was noted in 2009 that Impala Platinum, a mine based in Rustenburg in the North-west province of South Africa had 10 fatalities due to non-compliance with safety standards and procedures while 126 days lost time was due to safety stoppage. As a result of these safety stoppages, production declined by 12% to 6.8 million tonnes, refined platinum declined by 9% (950 000 ounces), therefore these lower volumes impacted on the unit cost (Impala Platinum 2009:54). Tang, Lee and Wong (1997:179) confirmed that the total cost of accidents depends on the application of safety controls. If the application is good, accident costs will be lower, and if it is poor, the costs will be higher and eventually this will result in an increase in the cost of production.

Mining is considered to be a dangerous occupation due to its inherent danger and mine employees failing to follow safety control procedures. This has resulted in the death of 168 mine workers and 3 672 mine workers being injured in 2009 while at work in South African mines (Department of Minerals and Energy 2010:74). The high injury and death rate in South African mines has resulted in a legislative framework being put in place by the government to ensure safety of mine workers. The legislative framework regarding safety controls, which includes the *Mine Health and Safety*

Act and Safety Regulations Act No. 29 of 1996 and relevant regulations, safety standards established and put into practice through the *Occupational Health and Safety Act No. 85 of 1993* as amended by the *Occupational Health and Safety Act No. 81 of 1993* as well as the *Labour Relations Act No. 66 of 1995* (Govender 2010:18) will be discussed. The *Constitution of the Republic of South Africa (1996)*, which requires the provision of a hazard free environment for every individual will also be taken into consideration (De Wall, Currie & Erasmus 2001:402). The government requires mines to abide by these Acts, regulations and standards to ensure safety in the workplace. The high incidence of miners' death and injury while at work as indicated in the statistics above emphasizes the necessity for safety control mechanisms to be a matter of major concern in South African mines. In order to make valid conclusions with regard to the study the following theoretical framework will be applied:

1.2. THEORETICAL FRAMEWORK

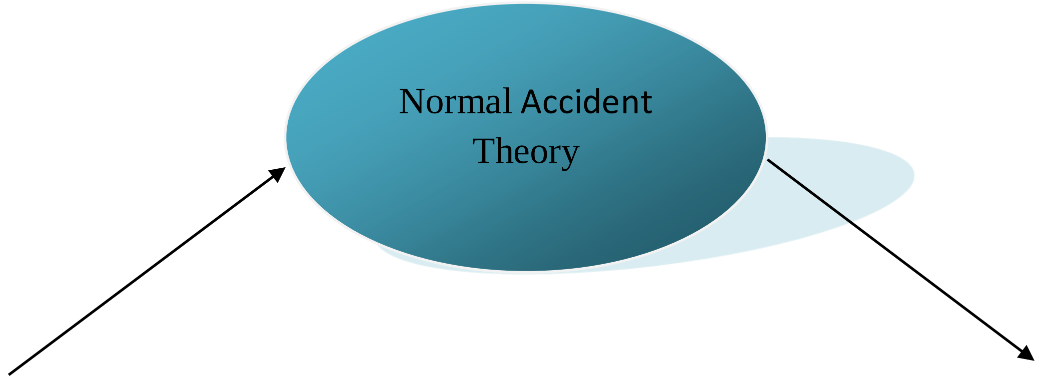
This study was based on the theoretical framework of Normal Accident Theory (NAT), originated by Perrow in 1984, and High Reliability Theory (HRT), founded by Sagan in 1993. NAT believes that no matter how hard organisations try or how effective safety devices are, accidental occurrences among organisations are unavoidable and as such should be regarded as normal (Perrow 1984:3). These accidents are caused by risks that cannot be eliminated as they are due to the complexity of the system and are therefore an inherent property of the system (Perrow 1984:7). In contradiction to NAT, HRT believes that if only organisations try harder, movement towards being an accident free system could be facilitated although a completely accident free system is difficult to guarantee due to human fallibility that will always be involved (Shrivastava, Sonpar & Pazzaglia 2009:1393). This study examined the consistency or inconsistency of the application of these theories on the mine in question.

The third theoretical framework for the study was Safety Control Cost Theory. The choice was informed by Son, Melchers and Kal (2000:187), who state that according to the theory of safety control costs; there is a relationship between safety controls and costs. Safety controls put in place determine the degree of safety to be achieved. Son *et al.* (2000:187) maintain that the higher the degree of safety, the lower the total cost as the chances of accident occurrence are reduced. To achieve the higher degree of safety, costs must be incurred to put safety measures into place and to provide training programmes for the employees. This may result in a reduced number of accidents, reduced costs incurred due to accidents and a reduction in the total cost (Caputo, Pelagagge & Palumbo 2011:1-2).

The study also adopted the Indirect Cost Theory of Accident Prevention lens to highlight the indirect or hidden costs that are incurred due to accidents but not attributed to accidents. These costs are absorbed by the employer but they are often ignored because the employers are not aware or informed about them; for example, wages paid to idling employees whose tasks depend on the output of the injured victim (Brody, Letourneau & Poirier 1990:255). These costs can be avoided through accident preventive measures (Brody *et al.* 1990:261). The study concluded that awareness of employers with regard to indirect costs enables them to take these costs into consideration. In so doing, it encourages employers to put into place accident-reducing activities which are considered to increase profits and thereby stimulate increased prevention (Brody *et al.* 1990:268).

Based on the aforementioned, it is evident that if accidents are normal, they will occur regardless of the safety measures in place and therefore this will result in organisations incurring costs related to accidents (NAT). On the other hand HRT declares that if safety measures are in place and are followed; there will be no accidents and therefore no costs will be incurred due to accidents. Indirect Cost Theory of Accident Prevention emphasizes that with investment in safety measures; accidents can be avoided as can the indirect costs associated with accidents. Furthermore, Safety Control Cost Theory acknowledges that the more organisations invest in safety measures the lower the accident occurrence rate and this results in reduction in costs within the organisation. For this reason the study was based on the conceptual scope outlined below:

1.3. CONCEPTUAL SCOPE



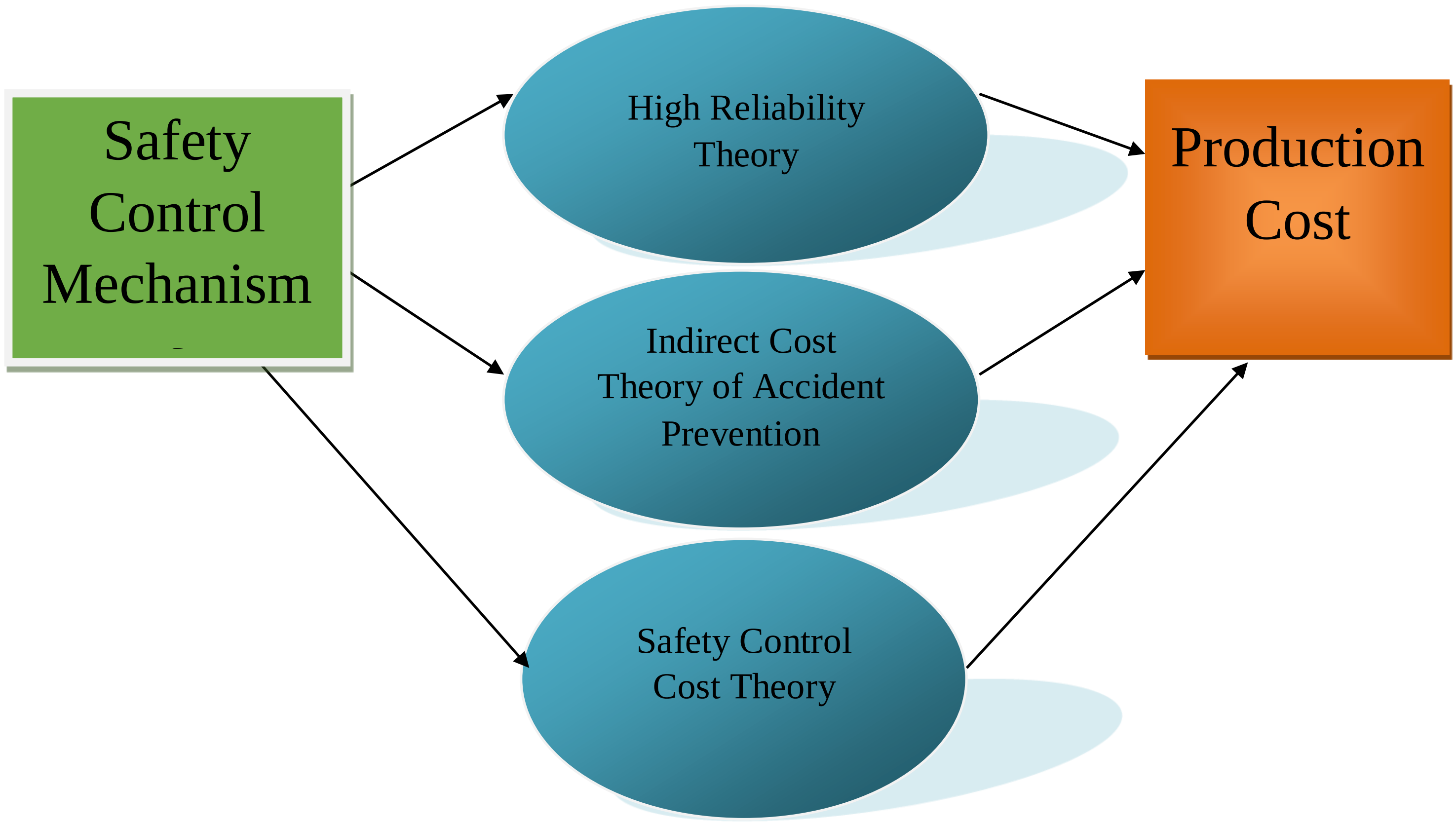


Figure 1.1: Conceptual framework

1.4. PROBLEM STATEMENT

A paramount concern within South Africa is the large incidence of accidents in the mining industry. The recent series of fatal accidents in the country's mines has drawn attention to South Africa. Biyase (2011) reported that accidents in South African mines resulted in the death of 67 mine workers from January to July 2011. It is stated that the death of mine workers at Harmony Gold's Unisel mine in Free State and Northern Platinum mine in Limpopo could have been prevented through the implementation of safety measures which were ignored by a number of mining companies due to costs involved. Therefore, South Africa is considered one of the many countries that have an unsafe working culture in mining (Naidoo 2010). This was confirmed by the former Minister of Minerals and Energy, Ms. Buyelwa Sonjica (2008), who reported that at least two hundred miners die every year and approximately six thousand miners are prone to injury at work per year. Gaps in safety standards in the mining industry were also identified (Sonjica 2009).

Miners who die in South African mines are often breadwinners for extended families, who depend on them for daily living expenses. The mine workers who are injured in these accidents suffer crippling injuries, leaving them in some cases with amputated limbs. They are often thereafter incapable of earning an income and they suffer a loss of quality of life and have high medical bills, resulting in human pain and misery among the victims and family members. Accidents in the mines also have an impact on the mining companies' production because of work stoppages (Hofman & Tetrick 2003:390). The main cause of accidents and fatalities in the mining industry is due to lack of safety controls. The absence of safety controls has resulted in the loss of economic potential and productivity in the country, owing to extended shutdowns of parts of the country's mining industry due to safety issues. Furthermore, mining companies may also incur far greater costs such as property damage due to accidents, and other indirect costs which are not captured by the accounting system (Hofman & Tetrick 2003:390). Inadequate implementation of safety control mechanisms affects the organisation's effectiveness and success as well as employee confidence, resulting in less favourable public relations and weakened potential to employ and retain employees (Mondy & Noe 2002:362).

Based on the problem statement, the following research question was formulated:

What are the perceptions of employees in relation to a South African mine's (Colliery) compliance with the safety legislation, adherence, commitment and attitude of employees towards the safety control mechanisms and the production cost?

1.5. OBJECTIVES OF THE STUDY

1.5.1. Primary objective

The primary objective of the study is to investigate whether or not the mine (colliery) in question adheres to the legislative requirements and has safety controls in place to ensure the safety of employees and to examine the production cost at the mine (colliery) in relation to safety control mechanisms.

1.5.2. Theoretical objectives

The following theoretical objectives are formulated in order to achieve the primary objective:

1. To conduct a review of literature on the legislation governing safety controls in the mining industry in South Africa and Canada.
2. To conduct a literature review on mine injuries and deaths due to lack of safety in South Africa, United States of America (USA), Australia and Canada.
3. To conduct a literature review on the two contradicting theories; Normal Accident Theory (NAT) and High Reliability Theory (HRT). NAT believes accidents cannot be prevented even with safety measures in place while HRT stresses that safety measures prevent accidents.
4. To conduct a review of literature on the Safety Control Cost Theory and the Indirect Cost Theory of Accident Prevention. These two theories agree that investments in safety control measures reduce the production cost in the long run.

1.5.3. Empirical objectives

The following empirical objectives are formulated:

1. To establish whether or not the mine conforms to relevant legislation regarding safety controls.
2. To determine whether or not the employees abide by the rules and apply the safety control procedures.
3. To ascertain the perceptions and attitude of employees towards safety control procedures.
4. To conduct an analysis of safety control mechanisms and production cost at the mine.
5. To identify sensible focus points to manage safety control procedures.

6. To determine the differences between groups (especially between employees in the mining and plant departments and non-production departments) in relation to safety, using One-way ANOVA and t-test.

1.6. SCOPE OF STUDY

The focus of the study is on the analysis of safety control mechanisms and production cost at a colliery in the Free State; a province in South Africa.

1.7. RESEARCH DESIGN AND METHODOLOGY

Research design is a strategy of investigation or the plan for conducting a research project. It is a framework that gives direction and systemizes the research project by showing how to solve a specific problem, indicating the steps that are necessary to provide answers to research questions to test the hypothesis and thereby achieve the research purpose. For this study a quantitative research paradigm was used (Lichtman 2006:17).

Quantitative research design determines the relationship between the variables in the population and seeks to explain that relationship in mathematical expressions and statistics. It is a technique that is intended to produce numerical data about the topic (Zikmund & Babin 2007:130-132). In this study this technique was used mainly to examine employees' perceptions with regard to: (1) organizational adherence or compliance to safety legislation, (2) employees' compliance with the application of safety control mechanisms, (3) employees' attitude towards safety control, and (4) production cost's relation to safety control mechanisms.

1.7.1. Sampling design procedure

Shiu, Hair, Bush and Ortinau (2009:485) state that sampling design is an explanation of the steps to be followed to ensure that the information collected represents the target population of the study. The sampling design for the study included a consideration of the following:

1.7.1.1. Target population

The target population (1 023 employees) for this study was restricted to the mine in question and its employees. Personnel in the protection and safety department, human resources management, technical services, plant, engineering, mining, administration and finance as well as redeployment formed part of the population. The target population also included the following employees: foremen, assistant pit-superintendents, supervisors and employees especially in the mining department as this is the area of main production and the most hazardous area of the mine.

1.7.1.2. Identification of the sampling frame

Gray, Williamson, Karp and Dalphin (2007:104) explain sample frame as a list of all elements or objects of the target population from which subjects were selected. The sample frame for the study was therefore made up of employees in the safety department, employee representatives (safety), mining department and employees from different departments of the mine in question. The list of all employees was obtained from the database of human resources department to determine the number of employees in different departments at the mine from which the sample was drawn.

1.7.1.3. Sampling technique

Sampling technique is the procedure that is followed in the selection of units to be used as representatives of the target population. It is divided into two categories: probability and non-probability sampling techniques. The method of probability sampling which was applied in this study will be the stratified random sampling method. In stratified random sampling the target population is divided into smaller groups or strata, based on the already known characteristics of the population's composition and it is essential for the sample to reflect all these characteristics (Zikmund & Babin 2007:415). For this study therefore, the population was made up of *inter alia*, different groups of employees from different departments based on the employees' relationship with risk. Participants were selected from each group so that the sample reflected each group in different proportions.

1.7.1.4. Sampling size

Sampling size is defined as the small number of subjects selected for the study whose characteristics exemplify the target population from which sufficient and accurate answers were obtained (Churchill & Iacobucci 2005:41). Against this background, the study sample consisted of both male and female employees from different departments at the mine. A total number of two hundred and eighteen (218) respondents were selected for the sample comprising employees from the safety department, the mining department as well as other departments inter alia, human resources and finance. Only 151 usable questionnaires were collected from the participants.

1.7.2. Method of data collection and measuring instrument

In order to collect information from the respondents, the study made use of questionnaires. A questionnaire is a written list of questions that respondents are asked to answer and it was divided into the following sections:

- Section A comprised questions on the demographic profile of the respondents that is: gender, designation, years of experience, home language, English proficiency, qualifications and department within the organisation.

Sections B, C, D and E covered the perceptions based questions as follows:

- Section B encompassed questions relating to adherence to or compliance with the Colliery safety legislations.
- Section C solicited information on the employees' compliance with safety control measures at the mine.
- Section D consisted of questions on employees' perceptions of and attitude towards safety controls at the mine.
- Section E included questions on safety control mechanisms and their relation to production cost at the mine.

Based on the above, a pre-test of the questionnaire was undertaken. Ten (10) employees consisting of the financial manager, human resources manager, assistant pit superintendent, safety officer, employee safety representative and five (5) randomly selected employees were asked to fill in the questionnaire prior to the main survey in order to have a comprehensive feedback and to enable the possible revision of the questionnaire. In addition to the pre-test, a pilot test was undertaken with 47 employees to establish the initial reliability of the questionnaire. After careful modification, the questionnaire was distributed to the participants. To activate this process data was collected through structured questionnaires using 5-point Likert scales to indicate the extent to which they agree or disagree with the statement and to generate quantitative data. The questionnaire was designed to provide a set of fixed alternatives from which the participants must choose an answer (Gray *et al.* 2007:132).

1.8. STATISTICAL ANALYSIS

The composition of the sample was evaluated through the use of firstly, the frequency tables which were used to classify the responses of the participants. Secondly, the descriptive statistics analysed measures of central tendency (mean) measures of spread (standard deviation) and measures of shape (kurtosis) of the respondents' perceptions. Thirdly, exploratory factor analysis was utilized to determine the latent variables under each of the four sections (B, C, D and E) of the measuring instrument and to establish construct validity. Lastly, ANOVA and t-test were applied to determine the differences between group means (Willemse 2009:118-121). The Statistical Package for Social Sciences (SPSS), version 21.0 for windows was used to analyse data.

1.9. RELIABILITY AND VALIDITY

The reliability and validity of the study refer to estimation of the truth or falsity of a given conclusion (Ary, Jacobs & Sorensen 2010:242). To determine the reliability and validity of the research instrument, a pilot study was conducted to test the measuring instrument. Reliability refers to the stability and consistency of the measuring instrument. It determines whether the tool that is used in research will provide the same information if used by different people, under the same conditions and at different times (Goddard & Melville 2009:41). Therefore, individual questions in the questionnaire were measured to determine consistency using Cronbach's alpha coefficient (Ary *et al.* 2010:242). Validity describes the extent to which an instrument accurately measures the concept it is supposed to measure (Goddard & Melville 2009:41). The following types of validity were examined:

Content validity determines whether the instrument used in the study takes into account all the meanings of the concept being measured. For this study, pre-testing was used to determine the relevance of questions in the questionnaire and also to ensure accurate measuring of the concept under study. Expert opinion was used to ensure that all aspects that make up the concept were covered in the instrument (Okubena 2010:137).

Construct validity demonstrates the relationship between concepts under study and the relevant theoretical concept. It determines whether or not the instrument is measuring what it is supposed or expected to measure. That is the degree to which the scale measures the theoretical construct (De Vos, Strydom, Fouche & Delport 2009:162). Construct validity was assessed using Cronbach alpha coefficients for the various scales.

1.10. ETHICAL CONSIDERATIONS

Ethics refer to the rules and the standards that were followed during and after the collection of data to ensure the protection of respondents. The study was carried out with high ethical standards. The respondents were notified on the right to abstain from participation. No respondent was pressured into participation and each respondent gave their consent to participation. The right of participants to privacy was respected and all participants were respected as individuals, and therefore the identity of all participants remained anonymous. The data collected as well as the mine records which were used in this study were treated as highly confidential. Written permission was obtained from the mine to conduct the research.

1.11. CHAPTER CLASSFICATION

Chapter one discussed in detail the introduction and the background of study, theoretical framework, conceptual scope, problem statement, study objectives, research design and methodology, statistical analysis, reliability, validity and ethical considerations.

Chapter two focused on the literature review of safety control mechanisms, legislative frame work in South Africa and Canada. It also provided a detailed overview of production cost.

Chapter three concentrated on the conceptual scope of the study, design and research method applied in the research. The sampling method, data collection techniques and statistical data analysis were discussed in detail in this chapter.

Chapter four provided the analysis of data generated and the interpretation of the empirical findings from the study.

Chapter five made available the conclusion and recommendations emanating from the study. Furthermore, the chapter explored the limitations of the research and areas of further research were recommended.

CHAPTER 2

OVERVIEW OF SAFETY CONTROL MECHANISMS AND PRODUCTION COST WITHIN THE SOUTH AFRICAN MINING INDUSTRY

2.1. INTRODUCTION

The previous chapter made available the background to the study, the problem statement and objectives of the study. Furthermore, a brief explanation of research methodology was presented. The objective of this chapter is to explore the issues surrounding safety controls and production cost within South African mining industry. The literature emanating from other related research reports is presented in order to understand the importance of occupational safety and safety control mechanisms, the implications of safety performance within the organisation and the need to change the approach towards safety to enable future improvements to occur with regard to occupational safety. In order to achieve the objective of this chapter, the legislation that governs this vital industry in the country, the theories that guide the study and the significance of safety legislation will be discussed.

Safety control mechanisms are the means, acts, methods or technical ways followed to prevent, eliminate or to mitigate organisational hazards (Laurence 2005:39). Safety control mechanisms can be in the form of rules, procedures, measures or standards that guide the performance of tasks or assist the employees in ensuring their own safety in the daily performance of their duties. According to Cao and Yang (2010:165) fatalities and injuries are preventable; tasks, however urgent or important can and should be done safely at all times. It is therefore the responsibility of everyone within the organisation to identify hazards as well as the risks associated with them so that those risks can be managed or controlled. Hence everyone within the organisation is responsible for ensuring their own health and safety as well as the safety of others specifically in the mining sector. To ensure occupational safety in the mines, safety measures must be put in place by the mining companies in accordance with the safety legislation that the government has promulgated. This legislation according to section 2, – *Mine Health and Safety Act No. 29 of 1996*

- was intended to guarantee the provision of a safe working environment for all mine workers in different mining companies through elimination or mitigation of hazards or danger (RSA 1996:11).

Safety within organisations involves the human factor which implies that human behaviour and individual qualities have to be taken into consideration as they have an impact or may have an impact on the environmental, organizational, health and security of the job (Korkut & Gedik 2010:1423). Therefore, the aim of occupational safety is to remove the dangers which may harm the workers in the workplace and to provide a hazard free working environment. Over and above the provision of a safe environment, it is necessary to reduce the insecurity in workers' behaviour by providing adequate rules, procedures and instructions on working safety together with the provision of adequate warning signs and signboards about occupational hazards and potential accident sites within the organisation. As a result it is of great importance to provide the employees with training and to educate them in relation to safety procedures to ensure confidence in the application of safety procedures and to reduce insecurity in the workers' behaviour (Korkut & Gedik 2010:1424).

Over the years, a high number of men left their families and homes behind searching for employment in the mining industry. However, many never returned due to fatal mining accidents. A large number of men who relocated to mining towns in quest of employment lost their lives in the mines. The study conducted by Eweje (2005:173) publicized that this is because the mining companies still do not have safety control mechanisms in place to make sure that the employees are safe while at work. On the other hand, if safety controls are in place; there can be a lack of awareness with regard to safety controls, lack of understanding which may be caused by lack of education and language barriers, ignorance and deliberate violations of safety rules and procedures by the employees. Laurence's study (2005:39) revealed that a high number of accidents in the mining industry resulted from people breaking rules, ignoring rules, or simply not knowing about them. Thomason and Pozzebon (2002:287) are of the view that the health and safety conditions can be improved within the workplace by reducing the probability of workers suffering injuries. This may also result in a decline in the cost of production which is increased by costs associated with workplace accidents and injuries.

Cost of production or manufacturing cost is defined as the combined cost of direct material, direct labour and overheads incurred in the manufacturing of goods or services. It is the sum of all resources consumed in the process of making a product or during the production of a service (Cloete & Marimuthu 2008:113). Van Rensburg *et al.* (2007:17) emphasize that direct material refers to the raw materials used to make the product. Raw material becomes direct material if it can easily be traced to the manufactured product. That is; the quantity used in the manufacturing of the product as well as the cost incurred in obtaining the material can be determined with ease, without any complexity. For example, one kilogram of flour bought at R15 and used to make one loaf of bread. Periasamy (2007:311) noted that direct labour is the cost incurred in the remuneration of workers who physically handle the direct material and convert it into a product. The direct labour would be the amount paid to the employees who knead the dough, put it into the baking tins and eventually into the oven. It is referred to as the direct labour because it can be related to the product and the cost incurred can be determined with ease. For example if the bakers take two hours to make one loaf of bread at R5 per hour, the direct labour cost per loaf would be R10.

According to Mowen and Hansen (2011:32) the third element of production cost is termed as the production (manufacturing) overheads (indirect costs). They are described as any cost that is incurred during production but cannot be directly attributed to one product. Production overheads are classified into three; indirect labour, indirect material and other indirect costs. Periasamy (2007:311) asserts that indirect labour refers to amounts paid to employees who provide activities that assist in production but do not physically handle the direct material to change it into a product. An example of indirect labour is the remuneration paid to the employees who wash the baking tins and clean the bakery floors. Mowen and Hansen (2011:32) confirm that indirect material is the material used during production but the usage is so minimal that it is too complex to determine the quantity used and the cost incurred towards one product. Examples are sugar and salt used in making one loaf. Lastly, other indirect costs are all other costs incurred during the manufacturing process other than indirect material and indirect labour. Examples include depreciation of ovens at the bakery and electricity used in the baking of the loaves of bread.

In conclusion, safety legislation is needed in order to provide guidelines and instructions to the mining companies and to provide a legal sanction which can be imposed by the courts on those who ignore good practice. The purpose of safety and loss prevention activities is to prevent accidents, fatalities and injuries and therefore avoid an increase in production cost due to accidents. Hence, it is necessary for the mining organisations to identify possibilities of potential accidents and then introduce the means of eliminating or reducing the chances of accident occurrence. Whilst this may be a normal practice or procedure for some industries, it is not always according to the same standard nor do all mines follow such good practice. In order to make valid conclusions about the results of this study, theories will be applied. A number of theories were developed in the previous decades to explain terms or variables, to make predictions and to explain why certain things happen based on the beliefs and practices. For the study at hand therefore, four theories will be used and are explained in detail later in this chapter.

2.2. THEORETICAL FRAMEWORK

According to Pandya (2010:21) a theory is a set of beliefs, statements, principles or propositions developed or devised to explain a group of facts or phenomena. It is regarded as correct due to the fact that it has been repeatedly tested and is therefore widely accepted. It can be used to explain a certain class of phenomenon or used to make predictions. It is a set of concepts that are integrated through a series of relational statements or a set of interrelated propositions which have been tested and are believed to be true (Pandya 2010:21). Against this background, the theories listed below will be used in the study to explain the impact on and the relationship between safety controls and production cost. Moreover, these theories will be used as guidelines for recommendations and conclusions pertinent to the study at hand. The following theories will be elucidated in the study:

- Normal Accident Theory by Perrow (1984);
- High Reliability Theory by Sagan (1993);
- Safety Control Cost Theory by Son, Melchers and Kal (2000); and
- An Indirect Cost Theory of Accident Prevention by (Brody *et al.* (1990).

2.2.1. Normal Accident Theory by Perrow (1984)

According to the Normal Accident Theory (NAT), accidents are inevitable and therefore regarded as normal (Perrow 1984:3). Shrivastava *et al.* (2009:1359) supported this theory and pointed out that no matter how hard organisations try to prevent and avoid accidents, accidents will always occur. However, the government of South Africa, in passing the *Mine Health and Safety Act No. 29 of 1996* (section 2), believes that accidents can be avoided. Consequently, it requires the mining industry in the country to abide by the requirements of the Act and to have safety control measures in place which are in accordance with the guidelines provided by this Act to ensure safety (RSA 1996:11). Heblewhite (2009:14) stressed that mining cannot have zero risk to health and safety; due to uncertainties of mining. There is always a possibility that accidents could occur during mining operations. Hence this study will determine whether or not the mine in question supports the theory and does not have safety measures in place as the theory states that there is nothing that can be done to prevent accident occurrences and are therefore considered normal (Cooke & Rohleder 2006:215).

2.2.2. High Reliability Theory by Sagan (1993)

On the other hand the High Reliability Theory (HRT) by Segan (1993) supported by Weick (2004:30), differs from NAT. According to the theory, if organisations try harder, movement towards being an accident free system could be facilitated regardless of how tightly coupled and complex the system operates. Reliability refers to the ability to maintain and execute error-free operations. The results of the study conducted by Lewis-Beck and Alford (1980:745) revealed that accidents can be curbed, even in highly dangerous activities carried out by fallible human beings. La Porte (1994:208) maintains that to ensure reliability, the following must be emphasized:

- Strategic prioritization of safety;
- Careful attention to design and procedures;
- Limited degree of trial-and-error learning;
- Decentralised decision-making;
- Continuous training; and
- Strong cultures that encourage vigilance and responsiveness.

Cooke and Rohleder (2006:216) argue that the success of high reliability can be ensured by avoiding the following:

- Uncertainty about accident causation;
- Politicized environments in which incident investigation takes place;
- The human tendency to cover up mistakes;

- The secrecy within the organisations with regard to accidents; and
- Ensuring commitment to training and high management priority on safety.

Saleh, Marais, Bakolas and Cowlagi (2010:1109) proposed that although accidents are normal, organisations can learn from incidents by putting a system in place to control the frequency and the severity of accidents. The study by Cooke and Rohleder (2006:216) further highlighted that organisations with controls in place can learn from incidents by reacting to these incidents through the putting in place of preventative measures in order to avoid serious accidents from happening and thereby move from normal accident organisations to high reliability organisations. This is referred to as the Incident Learning Theory propagated by Turner (1978).

Weick (2004:29-30) believes that while it may be normal for accidents to occur, serious ones can be prevented through the implementation of organisational practices that curb accidents. The study further suggests that if organisations implement business processes; mindfulness qualities will be instilled in the organisation. These qualities include preoccupation with failure, reluctance to simplify operations, sensitivity to operations, commitment to resilience and deference to expertise.

2.2.3. Safety Control Cost Theory by Son *et al.* (2000)

Son *et al.* (2000:187-188) posit that there is a relationship between safety performance and costs. Hence, a theory was propagated that the higher the design, implementation and safety levels to be achieved, the lower the overall costs will be incurred within the organisation. To achieve the higher levels of safety extra costs are incurred and these costs will normally be borne by the employer. It can therefore be concluded that under a perfect state of safety, there will be no accidents as a result there will be no costs associated with accidents. Based on the results, the study will establish whether or not the Colliery in question has safety measures in place to guarantee workplace safety. It will also determine whether or not the implementation and the application or the lack of safety control measures is perceived to increase or reduce the production cost at the Colliery under review.

2.2.4. Indirect Cost Theory of Accident Prevention by Brody *et al.* (1990)

Indirect Cost Theory of Accident Prevention affirms that for every accident that occurs, there are indirect costs incurred. Indirect costs are the costs that are incurred by organisations due to accidents but cannot be directly attributed to a specific accident (Cloete & Marimuthu 2008:114). Indirect costs are also referred to as hidden costs due to the fact that many employers are not aware of these costs. For this reason, these costs are not insured and are entirely absorbed by the employer. H. W. Heinrich (1959) who began analysing work accidents in the late 1920s concluded that indirect costs are substantially and generally a multiple of direct costs incurred due to accidents with an average ratio of 4:1 (indirect costs/direct costs) (Brody *et al.* 1990:260-267). It is believed that the sum of indirect costs due to accidents constitutes a potentially fruitful source of savings and is therefore likely to motivate owners to invest in preventive measures. For example, 350 disabling accidents in Quebec in 1988 incurred the indirect cost in excess of $1 100 per accident and $2 900 per time loss accident (Brody, *et al*. 1990:267). The authors revealed that by recognising the uninsured indirect costs and by making this information available to all employees; costs can be minimized through accident-reducing activities that are regarded as more profitable through prevention. This study will attempt to determine whether or not there are any indirect costs that are incurred due to accidents at this site and highlight the implications that these indirect costs have on the production cost at the Colliery under study.

According to the Safety Control Cost Theory and Indirect Cost Theory, costs are incurred in order to put accident prevention measures in place. These costs can be incurred due to safety training that is provided to employees, safety incentives, staffing for safety, provision of safety facilities and safety programmes in order to improve safety performance and as a result reduce accident costs. Investing in safety must be viewed as a means to improve the bottom line and naturally to reduce incidence of injuries. This is because if there is a high safety investment, the chances of incurring high injury cost becomes relatively low. On the other hand if investments in safety are low, the chance of sustaining high injury cost can be relatively high (Teo & Feng 2011:67). This was substantiated in the study by Son *et al.* (2000:192) at SI Construction Company in Korea over a period of three years (1993 – 1995). The purpose of the study was to investigate the model which could be used to estimate the indirect and direct cost of accidents and injuries with the intension of establishing the efficient safety control. The study concluded that when the rate of investment increased; the accident rate, direct cost, indirect cost, cost of damage and the total cost were reduced. However, if companies continue to increase investment in safety, this can trigger an increase the in total cost. This is illustrated in *Table 2.1* below.

Table 2.1: Interrelationship between safety investments and costs ($ Billion)

INVESTMENT RATE	ACCIDENT RATE	DIRECT COST $	INDIRECT COST $	COST OF DAMAGE $	COST OF CONTROL $	TOTAL COST $	COST DIFFERENCE $
0.0050	0.02564	9.6681	14.5022	24.1703	6.4650	30.6353	-
0.0060	0.02171	8.1884	12.2826	20.4709	7.7580	28.2289	2.4064
0.0070	0.01839	6.9351	10.4027	17.3378	9.0510	26.3888	1.8402
0.0080	0.01557	5.8737	8.8105	14.6841	10.3440	25.0281	1.3606
0.0090	0.01319	4.9747	7.4620	12.4367	11.6370	24.0737	0.9545
0.0100	0.01117	4.2133	6.3199	10.5332	12.9300	23.4632	0.6105
0.0110	0.00946	3.5684	5.3526	8.9210	14.2230	23.1440	0.3192
0.0120	0.00801	3.0223	4.5334	7.5556	15.5160	23.0716	0.0724
0.0130	0.00679	2.5597	3.8395	6.3992	16.8090	23.2082	-0.1366
0.0140	0.00575	2.1679	3.2519	5.4198	18.1020	23.5218	-0.3136
0.0150	0.00487	1.8361	2.7542	4.5903	19.3950	23.9853	-0.4635
0.0160	0.00412	1.5551	2.3326	3.8877	20.6880	24.5757	-0.5904
0.0170	0.00349	1.3171	1.9756	3.2927	21.9810	25.2737	-0.6980
0.0180	0.00296	1.1155	1.6732	2.7887	23.2740	26.0627	-0.7890
0.0190	0.00251	0.9448	1.4171	2.3619	24.5670	26.9289	-0.8662
0.0020	0.00212	0.8002	1.2002	2.004	25.8600	27.8604	-0.9315

Source: Son *et al.* (2000:189).

From the above discussion, it can be concluded that accidents can be avoided and prevented (to a significant extent), provided organisations have safety measures in place as indicated by the HRT. This can be achieved by improving the organisational design, avoiding mistakes, learning from accidents, decentralising the decision making process and also through continuous training of workers. Hence, an organisation can move from a normal accident organisation to a high reliability organisation through safety investments. That is, the more organisations invest in safety; the less the cost of accidents and therefore fewer accidents and injuries will be suffered by the workers. This should be considered by the South African mining industry specifically as it is characterised by the high number of accidents and injuries.

The open question is: What are the perceptions of employees in relation to the Colliery's compliance with the safety legislation, adherence, commitment and attitude of employees towards the safety control mechanisms and the production cost? The study aims to answer this question by reaching each objective, especially the first four empirical objectives which are: (1) Colliery's safety compliance, (2) employee safety commitment, (3) attitude towards the safety measures, and (4) application of production cost as a basis/instrument to determine the perceptions of employees in different departments within the theoretical framework.

2.3. SOUTH AFRICAN MINING INDUSTRY EXPLAINED

The mining industry in South Africa originated in 1852 in Springbok and the Northern Cape. In 1867 a diamond was found on the river banks of Orange River and in 1869 more large diamonds were found in the Northern Cape; which led to diamond rush to the Pilgrims Rest and Barberton areas involving numerous freelance diggers. This appealed to European fortune seekers who started coming into the country and started the mining operations in South Africa. Even then, it took the discovery of gold and the development of the Witwatersrand in the last decade of 19th century and the first decade of the 20th century to give substance to earlier foundations which resulted in the economic growth of the country and the foundation of Gold Fields South Africa by John Cecil Rhodes (Pogue 2000:2). Kearney (2012) confirmed that mining in South African still continues to be a vital and important industry in relation the country's economic growth and development. It has been a significant and powerful force in the growth of the South African economy and other African economies. Although there has been a drop over the years regarding the contribution of the mining industry to South Africa's gross domestic product (GDP), the industry still remains the foundation of the economy of the country with its job creation and foreign exchange earnings. According to the Annual Report of the Department of Mineral Resources - DMR - (2012:20), mining industry contributed R260.4 billion (US$31.5 billion or 9.8%) to the GDP and accounted for 37.8% of the country's total exports of goods to the rest of the world.

The mining industry in South Africa has been the major and important economic driver due to its ability to create employment as indicated in *Table 2.2*. It is South Africa's principal employer within the country with about 500 000 employees and a further 500 000 employees within the industry that provide goods and services required in the mining industry (Maia 2012). In 2011 the mining industry in South Africa produced around 53 different minerals from 1 592 mines and quarries (DMR 2012:1). South Africa is one of the leading producers of valuable and costly minerals like gold, diamonds, platinum and coal; with coal and iron ore accounting for 82% of South Africa's mineral sales (Chamber of Mines 2012:2). The coal produced in South Africa throughout the years has been the main source of energy, leading the indigenous energy base in the country. It accounts for 94% of electricity generation through coal power plants (Kearney 2012). This is unlikely to change substantially in the coming years due to absence of suitable replacements for coal (Chamber of mines 2010:74). Hence, more coal mining projects are needed in the South Africa in the future.

Table 2.2: Number of employees in South African mines; 2002-2011

YEAR	NO. OF EMPLOYEES
2002	415 988
2003	435 628
2004	448 909
2005	444 132
2006	456 337
2007	495 150
2008	518 519
2009	429 219
2010	498 906
2011	513 211
2012	514 760
2013	524 632

Source: Department of Mineral Resources (2012:24) and Chamber of Mines (2013:12).

Although minerals are non-renewable or exhaustible resources, the economy of South Africa is dependent on the utilisation of its natural resources; it is still reliant on the activities of the local mines (Creamer 2010). Hence, this makes mining a very important industry in the South African economy as it has always been even during the apartheid era.

2.3.1. Mining industry in South Africa: Apartheid

Mining industry created jobs even during the apartheid era. But as the number of African workers increased in 1923, the Native Urban Areas Act No. 21 was put into practice. The Act limited the movement of black Africans and condensed the employment and appointment opportunities of black people for high positions within the mining industry. This Act required black people to have 'passes' and these passes were used to ensure that skilled and educated natives did not get the opportunity to do the jobs that they were skilled or qualified to do. This was to make certain that the black people were no competition to the white population (Seekings 2007:379). Poor white workers were appointed and paid the rates paid to semi-skilled and skilled workers while Africans were appointed as unskilled workers regardless of their skills or qualifications (Seekings 2007:383). African workers were not denoted as employees according to the contents of the Industrial Conciliation Act No. 11 of 1924. These workers were not permitted to become members of trade unions. If the black workers chose to belong to a trade union; these trade unions were rejected, refused registration and therefore not given any acknowledgement by the state. Due to the fact that they were not allowed to be members of registered unions, they were not allowed to strike. Hence, strikes by these workers were considered illegal (Lichtenstein 2005:297-298). Only white workers were permitted to be members of registered trade unions and benefits were restricted to such trade unions. There was complete inequality between black and white workers even down to the protective clothing for fire risk and heat (Landis 1962:437)

During those days the working condition were very bad for the black population due to apartheid however, the African mine workers had the worst working conditions. The work in the mines was harder and unhealthier, due to volatile and severe working conditions. Mine workers were secluded and were forced to live in barracks for a period of a year or more away from their families and the lack of all normal human interaction was exceptionally galling. On the other hand working conditions of European workers were continually improved (Landis 1962:437). The danger of coal and gold mining was well known in South Africa. The mining industry made use of unskilled black workers with the apartheid laws restricting them to low-paid labour and skilled work was reserved for Whites (Pogrund 2010). This situation received international exposure due to the Coalbrook disaster at a mine named Clydesdale Colliery; a mine which was 22km from Vereeniging. The tragedy happened on the 21st January 1960 and it killed 435 mine workers due to collapsed pillars (Van der Merwe 2006:858). 429 black mine workers died in this accident and only 6 were white

(Pogrund 2010). The bodies in that accident were found, however, the industry lacked suitable equipment to dig them out. Therefore, the bodies were never recovered. The miners were not treated equally in relation to work and pay and this was carried over into death as only the White miners' widows were eligible to receive lifelong pensions of up to £396 a year but there was no pension for black widows except a once off payment not exceeding £252 (Pogrund 2010).

2.3.2. The Mining industry in South Africa: Post-Apartheid

The Mining industry is still continuing to create jobs within the industry as indicated in *Table 2.2* and contributing massively to the economic progression of the country. This table indicates a trend. Although it is now two years out of date, the trend continues. The end of apartheid in 1994 - *Mine Health and Safety Act No. 29 of 1996* section 29 to 30 - gave the mine workers a say concerning the working conditions in relation to safety (RSA 1996:34). The end of apartheid government led to new information about the activities of the companies as well as the health and safety policies. Mining companies began to work together in collaboration with the government agencies and the miners' trade unions in relation to the safety of mine workers. This co-operation commenced with discussions between these institutions in order to determine what can be done to reduce accidents and to prevent loss of life in the mines and as a result, improve the image and public perception regarding the business practices within the mining industry (Eweje 2005:171). Employees now have the right to strike and to be members in registered trade unions which are recognised by the state.

Democracy has provided mine workers with an opportunity to be appointed as skilled workers and the chance to occupy high positions within the mining industry, to be part of discussions encompassing the pay rate, work safety as well as the right to strike (Baleni 2011). However, these strikes have a negative influence on the economy of the country as the President of South Africa Mr. Jacob Zuma stated on the 23rd May 2013. The President stressed that it is the right of mine workers to strike as enshrined in the Constitution; however, it is not helping the economy. In the speech the President declared that,

> "…If we say we need more jobs and in the process those that are working are engaged in strikes that cause some of mines to close, it is a contradiction. We should demand better working conditions and salaries but we may not wreck the economy."

According to Maswanganyi (2013) strikes in the mining sector have resulted in the International Monetary Fund dropping South Africa's economic growth prediction to 2% for 2013 from 2.8%. The National Treasury Director-General Mr. Lungisa Fuzile (2013) believes that the strikes and instability within the sector have resulted in the weakening of the rand.

It is evident that the mining industry plays a major role in the growth of the South African economy. However, this growth can no longer be guaranteed due to strikes within the mining industry. This is a very important industry in the country regardless of its hazardous nature, which makes mine safety a crucial issue.

2.3.3. Safety control mechanisms within the South African Mining Industry

Safety mechanisms as defined by Korkut and Gedik (2010:1423) are all the 'methodized works' used to identify, examine and prevent the dangers, harm and functioning problems as a result of working conditions in the working place for workers, with its machines and facilities for production. Even though South Africa is renowned for its large quantity of mineral resources, the accident statistics in the South African mining industry are still high. Over the years the mining industry has managed to reduce the number of fatalities due to accidents within the industry. Yet, safety continues to be a major challenge in South Africa as some mining companies still fail to provide a safe working environment for the mine workers (Chamber of Mines 2013:28). Nevertheless, there are those mining companies that do their utmost best to provide rules, procedures and standards to ensure safe workplaces and the safety of their employees.

Although some companies make an effort to ensure the safety of employees; the study carried out by Laurence (2005:39) involving operators in underground coal mining found that a large percentage of the workforce were of the opinion that it was necessary to break the rules in order to get the job done. This was substantiated and confirmed by Paul and Maiti (2007:50) that risky behaviour is found to be the common cause of accidents. Safety measures can be put in place but if these measures are overlooked and not applied, accidents will occur and result in injuries and fatalities. For this reason, the safety culture within an organisation should be improved. Lu and Tsai (2008:595) define safety culture as

> "…the principles, standards, attitudes, views, competencies and patterns of behaviour that indicate the commitment of employees to safety, the style and the know-how of an organisation's health and safety management."

This means that in order to ensure safety and to prevent accidents, management's commitment is essential; follow-up and enforcement of the application of safety rules and procedures is also essential. This can be achieved through the allocation of resources towards safety controls and implementation of ways and means to better understand the reasons why employees ignore or break rules or why the rules are ineffective. Consequently, it is necessary to assess the attitudes and the perceptions of employees regarding safety and safety procedures of the Colliery under study (Laurence 2005:41).

According to Pless and Hagel (2009:182) an accident implies an event beyond anybody's control, even the government. Based on the aforementioned, it is an unexpected or chance event and therefore cannot be avoided or prevented. The authors are of the view that accidents can occur anywhere and at any time. Nevertheless, the government of South Africa believes that accidents are preventable only if precautions are taken to eliminate hazards that can cause accidents. The people who work spend most of their time at work, therefore are prone to disasters when exposed for long periods to identified and unidentified hazards. Hence employers and the employees have the responsibility to make certain that the workplace is free of any harm or hazards and ensure that the workplace is safe for the employees. If it is impossible for hazards to be eliminated these hazards must be mitigated or controlled. In order to prevent possible accidents or to reduce the harmful degree of accidents to an acceptable level, it is necessary to eliminate the factors that might lead to serious injury or loss of life by implementing safety measures in accordance with the guidelines provided by the government. Section 2 of *Mine Health and Safety Act No. 29 of 1996* provides guidelines instruct the mining industry as to what should be done and what should not be done to ensure the safety of the employees (RSA 1996:2). However; some of the mining companies still fail to adhere to safety requirements due to costs associated with implementation of safety measures.

It can therefore be deduced that safety in the South African mining industry is of great concern as mining companies still fail to comply with the safety legislations and therefore fail to provide safe working environments for the mine workers due to implementation costs. As a result mine workers in South Africa are all too frequently fatally injured or suffer crippling injuries. Furthermore, mining companies are being shut down due to lack of safety. This negatively affects the economy of the country which is still reliant on the mining activities. Mining companies need to commit themselves to and abide by the Safety Acts and Regulations applicable to the mining industry. In so doing, this will encourage the mine workers to take responsibility for their own safety and the safety of other employees in the mines. This will also improve the economic growth and therefore the quality of life of Mine workers. All safety procedures should be followed at all times and not ignored in order to get the job done as this can result in accidents and injuries that are costly to the companies. As a result one of the main concerns of mining companies in South Africa is to cut costs of accidents while improving mine safety.

2.3.4. Cost control within the South African Mining Industry

Employees in the coal mining industry are exposed to known and unknown hazards and as a result the chances of miners being involved in an accident are very high. They are more likely to be killed or suffer severe non-fatal injuries than the employees in the private industry as a whole. According to the United States Bureau of Labour Statistics fatal injuries in the coal mining industry in Turkey were nearly twelve times the rate of private industry (Sari, Selcuk, Karpuz, Sebnem & Duzgun 2009:76). In the United States of America, the average cost of accidents is considered to be $1 million per year with an average cost of $5 000 per accident. In Turkey this industry ranks first in occupational diseases and permanent disabilities with $4.3 million lost due to accidents in a year without considering the indirect costs (Sari *et al.* 2009:79). In Canada an estimated $492 000 is incurred due workplace fatalities while on the other hand South Africa loses R6 million (R6 000 000 / $12.36 = $485 436.89) in direct costs when a miner dies and also another R6 million ($485 436.89) in indirect costs for retraining of employees, looking after the deceased's family, the cost of insurance and the immeasurable relational costs (Creamer 2010).

Based on the aforesaid, it is important for human resources and safety professionals to turn towards safety programming and implementation of safety legislation in an effort to reduce injuries, fatalities and costs (Kelloway, Stinson & MacLean 2004:116). However, Muth, Karns, Wohlgenant and Anderson (2002:187) argued that safety legislation increases the cost of production and that this results in more businesses closing down and smaller numbers of businesses entering the industry. It was highlighted in this study that the enactment of safety legislation drove small businesses out of the industry as this increased the cost per unit due lower quantities produced in small businesses. This resulted in the higher cost per unit for smaller businesses compared to large businesses. This is because big businesses can allocate the cost over a large number of products while smaller businesses produce a small number of products which have to absorb the entire cost of applying the safety legislation (Muth *et al.* 2002:188). Hence controls are viewed to have a tendency to increase costs and are perceived to be negatively affecting the competitiveness of the United Kingdom business and European Union as a whole (Heasman & Henson 1997:181). Compliance with the legislation is seen as decreasing profitability and wasting management time and money on non-productive activities.

While companies are of the opinion that the safety legislation is burdensome and that it involves enormous costs in the implementation of safety measures; Martinez (2007:300) acknowledged that the future of organisations rests upon minimizing hazards at every step. It is believed that this helps organisations towards the achievement of zero hazards. According to Gupta, Hendershot and Mannan (2003:408) the organisations that started putting into practice the safety controls are already realising the rewards in terms of profit, public acceptability and respect. It is also stated that the costs that were incurred in controlling hazards decreased considerably if not totally wiped out as the concepts of safer approaches were applied. In the United States of America, Presidents Reagan, Bush and Clinton had confidence in the Regulatory Impact Assessment (RIA) and as a result during their presidency they ordered and ensured that RIA on the safety legislation was conducted and implemented. It was found in the study carried out by Antle (2000:321) that the potential benefits of the legislation could be around $3.7 billion per year whereas the costs of implementation were estimated to be $0.1 billion. These assessments concluded that the benefits are greater than the costs by such a wide margin. Antle (2000:321) believes that if organisations could increase safety; perhaps even completely eliminate all risks at a cost estimated at $0.1 billion, if the legislation is 100% effective benefits will outweigh the costs. Due to the fact that benefits of safety are considered to be more than the costs. Therefore; Antle is of the opinion that safety should be viewed as providing a ‘free lunch’. Hence South African mining industry is committed to the implementation of safety controls as contained in the legislative framework of this country to reduce a vast majority of accidents, deaths and certainly costs by 2013 (Creamer 2010). At this point, the legislative framework that governs safety in South African mining industry will be addressed.

2.4. LEGISLATIVE FRAMEWORK OF MINING INDUSTRY IN SOUTH AFRICA

Studies on safety and safety control mechanisms revealed that mine workers in South Africa are exposed to challenging mine environments since the working areas degrade fairly easily as the mining progresses (Hermanus 2007:531). This can be attributed to dust and noise that are naturally related to rock breaking, blasting as well as the changing mining environment due to the mining operation which sometimes results in the release of dangerous gases into the underground air spaces. Physical hazards are also developing from the use of new forms of mining processes, hazards due to the heavy equipment used by miners often in confined and restricted spaces. This contributes towards making the working environment more challenging for miners (Hebblewhite 2009:15). Due to the inherent danger of mining, the government has safety legislation in place as mentioned earlier to ensure the safety of mine workers. The government believes that if the mining industry tries harder, the country can have an accident free mining industry. Before further review of the current legislation with regard to mine safety in South Africa, a cursory look at the South African history of mine safety legislation may be appropriate at this stage.

2.4.1. Apartheid mine safety legislation in South Africa

For decades South Africa was wrapped up in racism as a result it made use of foreign labour. This enabled the government to control the labour force so that there was no question of strikes which were considered illegal within the country. The immigrant labour system also gave management dominance over labour (Landis 1962:437). Due to apartheid, miners could not force the mining corporations to improve working conditions and the mining companies were not obliged to improve the health and safety of black mine workers. In addition, the high number of the mining workforce was illiterate and innumerate (Leon 1995:14). This is because the apartheid policies calculatingly and intentionally side-lined the blacks by making it impossible for the black man to attain educational qualifications and training. As a result black mine workers were not considered for supervisory positions (Coupe 1996:46).

Due to lack of education, skills and understanding; black miners could not do anything to ensure their safety and to prevent accidents although they constituted 90% of the mining industry labour force. For many years black workers were at the bottom of the organisational pyramid while white workers occupied high positions within the mining industry (Coupe 1996:48). The study conducted by Eweje (2005:173-174) concluded that:

"….(1) black workers had no legal recourse to higher officials to challenge the decisions of the white miners about safety in the workplace; (2) management policy was perceived as work first, report later and; (3) refusal to work on account of perceived hazards was met by a disciplinary action."

The study also concluded that safety was a serious issue for mine workers in the apartheid era which did not care about the black mine workers. This is consistent with the statement made by Cecil John Rhodes,

"….You will remove them, the natives, from the life of sloth and laziness, you will teach them the dignity of labour, and make them contribute to the prosperity of the state and give them some good return for our wise and good government" (Leon 1995:10).

This statement therefore shows that mining companies were in support of the apartheid government however, mining companies denied this.

Ever since the end of the apartheid era, the mining companies have started training the black miners to reduce distrust, to do away with the violation of fundamental human rights and discontinue unethical behaviour against the black mine workers. The safety legislation in the South African mining industry began in 1904 when the first mining legislation, British Coal Mining Regulations were put in force in the country (Eweje 2005:174). Due to high risks associated with the mining industry in South Africa especially with the underground mining, the government put in place the safety legislation in the country's mines – *the Mines and Works Act No. 27 of 1956* and the *Occupational Diseases in Mines and Works Act No. 78 of 1973*. These acts provided for the control of the work environment on the mines to ensure safe workplaces. Inappropriately; this legislative framework was used to reserve certain duties for particular racial groups due to lack of skills and training among the black mine workers and as a result only white miners qualified as "scheduled persons" who were responsible for carrying out many crucial duties and perform standard safety procedures (Coupe 1996:48).

Some industrialists considered incorporating black workers to ensure that they also have the opportunity to occupy managerial positions but the reigning of the Nationalist Party wanted to uphold the colour bar in the labour market to ensure that black Africans only had the opportunity to occupy positions for unskilled labour and low remuneration. To ensure and to maintain this, intelligence tests were performed; yet these tests did not show any differences between black and white South Africans with regard to performance (Coupe 1996:44). For this reason therefore, the government put together the Leon commission to investigate the aspects of the legislation regarding the health and safety in the mining industry according to the definition contained in the *Minerals Act No. 50 of 1991 as amended by Minerals Amendment Act No. 103 of 1993, Mine Health and Safety Act no. 29 of 1996* and *the General Law Fourth Amendment Act No.132 of 1993.* The Commission had to make recommendations to the State President on the improvements to the existing regulations and the implementation thereof in the light of the circumstances prevailing in the industry and of international standards. According to the findings of the commission, South African injuries and fatalities were unacceptably high (Leon 1995:16-19).

The Commission made recommendations after reviewing the apartheid laws in relation to the safety of miners. It recommended that the new Act should be drafted that will be devoted to ensuring the health and safety only in the mining industry and that the main section of the Act, preamble should read,

"….An Act to provide an improved structure for the regulation and improvement of the health and health and safety of those employed in the mining industry" (Leon 1995:113-115).

After the end of the apartheid era in 1994 the new legislation was put in place to ensure the safety of all mine workers regardless of race or colour.

2.4.2. Post-apartheid mine safety legislation and policies in South Africa

Currently, mining operations are subject to an industry-specific Act promulgated to improve and protect the health and safety of all mine workers. There are several other Acts and laws that exist within the country but these are not mine-industry specific, however they have a direct impact on the delivery of mine safety and fair labour practices. Legislation pertaining to occupational safety in South Africa is as follows:

- *The Constitution of the Republic of South Af*rica;
- *Basic Conditions of Employment Act No. 75 of 1997;*
- *Occupational Health and Safety Act No. 85 of 1993;*
- *Labour Relations Act No. 66 of 1995; and*
- *Mine Health and Safety Act No. 29 of 1996.*

2.4.2.1. The Constitution of the Republic of South Africa

The Constitution of the Republic of South Africa, *1996*, was approved by the Constitutional Court (CC) on the 4th December 1996 and took effect on the 4 February 1997. The Constitution is the supreme law of the land and no other law or government action can supersede the provisions of the Constitution. Section 24 (a) of Chapter 2 which is the Bill of Rights of the Constitution, states that all people have the right to an environment that is not harmful to health or well-being. This therefore includes the mine workers. The Constitution requires the employers to provide mine workers with the working environment that is safe, hazard-free and not harmful to the employees or anyone who is affected by the activities of the mine (RSA 1996:1).

In conclusion, with this legislation, the government tried to ensure that the rights of employees are not overlooked and that organisations strive for the provision of a hazard-free working environment for the employees.

2.4.2.2. Basic Conditions of Employment Act N0. 75 of 1997

The *Basic Conditions of Employment Act No. 75 of 1997* was published for general information on the 5th December 1997. The purpose of this Act was to give fair effect to the labour practices referred to in section 23(1) of the Constitution by establishing and making provision for the regulation of basic conditions of employment, and thereby complies with the obligations of the Republic of South Africa as a member state of the International Labour Organisation. The Regulations and the requirements of the *Occupational Health and Safety Act No. 85 of 1993* will be discussed in detail later in this chapter (RSA 1997:8). Furthermore section 7 (b) requires the employer to regulate the working time of each employee with due regard to the health and safety of the employees (RSA 1997:14). While Section 17 (i) states that the employer may only require or permit the employee to perform night work, if so agreed and if the employee is informed in writing, or orally. If the employee is not able to understand a written communication, in the language that the employee understands, he must be informed of any health and safety hazards associated with the work that the employee is required to perform (RSA 1997:20). The Act also observes the requirements of *Mine Health and Safety Act No. 29 of 1996* discussed in detail later in this chapter (RSA 1997:72).

With these Acts the government requires the employers to be transparent with the employees with regard to the risks that are associated with the work that must be done. This will give the employees the opportunity to decide for themselves whether to perform the tasks regardless of the risks involved or to refuse the performance of such tasks. The Act also observes the requirements of Occupational Health and Safety Act explained in detail below which encourages the employer to train the employees and provide procedures that have to be followed in order to avoid harm.

2.4.2.3. Occupational Health and Safety Act No. 85 of 1993 as amended by the Occupational Health and Safety Act No. 181 of 1993

This Act took effect on the 2nd July 1993. The principle characteristics of this Act are:

- To provide for the health and safety of people at work;
- To provide for the health and safety of people in connection with the use of plant and machinery; and

- To ensure the protection of people other than those at work against hazards to health and safety in connection with the activities of people at work.

The purpose of this Act is to ensure that the employers provide a safe working environment for all employees in different industries including those who are working in the mining industry by:

- Providing and maintaining a working environment that is safe, without risk to the health and safety of the employees and maintaining the system of work to ensure that plant and machinery are safe and without risks;
- Eliminating or mitigating any hazard or potential hazard to the safety or health of employees before resorting to personal protective equipment;
- Ensuring safety and absence of risks to health in connection with the production, processing, use, handling, storage or transportation of articles or substances;
- Providing information, instructions, training and supervision to ensure the health and safety of the employees at work; and
- Making employees aware of the hazards attached to any work that the employees have to perform, any article or substance which has to be produced, processed, used, handled, stored or transported, any plant or machinery which employees are required or permitted to use as well as with the precautionary measures which should be taken and observed with respect to those hazards.

To ensure that the employers meet the above requirements of the Act the employees must adhere to the following:

- Take reasonable care to attend to the health and safety of themselves and of other people who may be affected by their acts or omissions;
- Cooperate with the employer to enable duties of employer as imposed by the Act to be performed or complied with;
- Carry out any lawful order given to them and to obey the health and safety rules and procedures laid down by the employer or by anyone authorised to do so by the employer in the interest of health and safety; and

- Report any situation that is unsafe or unhealthy that comes to an employee's attention and any incident which may affect their health or the health or other employees as soon as possible to the employer or to the health and safety representative (Govender 2011:7-8).

To conclude, the purpose of this Act is to ensure the provision of a safe working environment, equipment, machinery as well as the rules and the standards to be followed to ensure safety of all people at work.

2.4.2.4. Labour Relations Act No. 66 of 1995

The *Labour Relations Act No. 66 of 1995* was promulgated on the 13th December 1995. This Act also observes the requirements of the *Occupational Health and Safety Act No. 85 of 1993*. Besides the requirements of the *Occupational Health and Safety Act No. 85 of 1993 as amended, section 78 of the Labour Relations Act* insists on the constitution of the workplace forum. One or more members of the workplace forum should be health and safety representatives. The employer should consult with the workplace forum whenever there is a need to initiate, develop, promote, monitor and review measures to ensure health and safety at work (RSA 1995:65).

With this Act the government encourages fair labour practices for all employees as conferred by section 23 of the Constitution. It also requires the employers to ensure the safety of employees as required by the Occupational Health and Safety Act which is observed by this Act.

2.4.2.5. Mine Health and Safety Act No. 29 of 1996

The promulgation date of this Act is the 14th June 1996. The principle features of this Act are:

- The primary responsibility for ensuring a healthy and safe working environment in mines is placed on the mine owner. The Act sets out in detail the steps that employers must take to identify, assess records and control health and safety hazards in the mines.

- The Act entrenches basic worker rights, most notably, the right of workers to participate in health and safety decisions, the right to receive health and safety information, the right to training and the right to withdraw from the workplace in face of danger.

- The Act establishes representative tripartite institutions to promote a culture of health and safety and to develop policy, legislation and regulations.

- The responsibility for enforcing *Mine Health and Safety Act* lies with the Mine Health and Safety Inspectorate. The inspectorate's powers have been recast and include the power to impose administrative fines upon employers who contravene the *Mine Health and Safety Act*. The Act also contains innovative approaches to the investigation of accidents, diseases and other occurrences that threaten the health and safety of employees (Botha 2003:6-8).

The purpose of the Act is to provide protection of health and safety to employees and other people in the mines by:

- Promoting a culture of health and safety;
- Providing the enforcement of health and safety measures;
- Providing for appropriate systems of employee, employer and state participation in health and safety matters;
- Providing effective monitoring systems and inspections, investigations and inquiries to improve health and safety;
- Promoting training and human resources development;
- Regulating employers' and employees' duties to identify hazards and eliminate, control and minimise the risk to health and safety; and
- Providing for investigations and inquiries to improve health and safety at mines;
- Giving effect to the international law relating to mining health and safety (RSA 1996:2).

To ensure that the Act serves its purpose, the owners or managers are required to do the following:

- Provide conditions for safe operations and a healthy working environment;

- Ensure that the mine is commissioned, operated, maintained and decommissioned in such a way that employees can perform their work without endangering the health and safety, of themselves or of any other person;
- Identify relevant hazards and assess the related risks to which employees are exposed and to ensure an adequate supply of health and safety equipment to each employee and therefore make available all the necessary health and safety facilities. These facilities and equipment must be serviceable and in a hygienic condition;
- Ensure sufficient quantities of all necessary personal protective equipment are available so that every employee who is required to use that equipment is able to do so;
- Determine capabilities of employees in respect of health and safety before assigning tasks; provide employees with any information, training, instructions or supervision that is necessary to enable them to perform their work safely without risks to health and safety. Supervision must be performed by a person trained to understand the hazards associated with the work and who has the authority to ensure that the precautionary measures laid down by the manager are implemented;
- Establish a health and safety policy which describes the organisation of work and the protection of employees' health and safety at work. The copy must be prominently displayed for the employees to read and the health and safety representatives must have the copy of the document; and
- Ensure that every employee is familiar with work-related hazards and risks and the measures that must be taken to eliminate, control and minimise those hazards and risks. In so far as the risk remains:
  - (i) provide personal protective equipment and safety facilities; and
  - (ii) have a programme that monitors the employees' risk exposure.

The manager or the owner cannot do this alone, therefore the employees must also abide by the Act and the duties of employees are as follows:

(a) To take reasonable care to protect their own health and safety as well as the health and safety of other people who may be affected by any act or omission of that employee;

(b) To use and take proper care of protective clothing as well as the health and safety facilities;

(c) To report promptly to the immediate supervisor any situation which the employee believes presents a risk to the health and safety and which the employee cannot properly deal with;
(d) To co-operate with any person to permit compliance with the duties and responsibilities placed on that person in terms of this Act; and
(e) To comply with prescribed health and safety measures and to leave any working place whenever circumstances appear to pose a serious danger to safety (Botha 2003:6-14).

Section 41 of the *Mine Health and Safety Act No. 29 of 1996* requires the establishment of tripartite institutions which consist of Mine Health and Safety Council, permanent committees of the council and the Mining Qualifications Authority.
The Council should consist of:

(a) Five members representing owners in the mining industry.
(b) Five members representing employees in the mining industry.
(c) Four members representing departments of the State.
(d) The Chief inspector, who must chair the Council.

Duties of the council are as follows:

- To advise the minister on health and safety at mines;
- To co-ordinate the activities of its committees, receive reports from the committees and liaise with the Mining Qualifications Authority on matters relating to health and safety;
- To liaise with any other statutory bodies concerned with matters relating to health and safety;
- To promote a culture of health and safety in the mining industry;
- To arrange and co-ordinate a tripartite summit to review the state of health and safety at mines at least once every two years; and
- To perform every duty imposed upon the Council in terms of this Act.

Duties of permanent committees

- The Mining Regulation Advisory Committee must advise the Council on the following:
  - Proposed changes to legislation to improve health and safety at mines;
  - Proposals for changes to legislation made by any other committee of the Council;

    - Guidelines for codes of practice; and
    - Standards approved by the South African Bureau of Standards.

- The Mining Occupational Health Advisory Committee should also advise the Council on the following:
    - Policy relating to health;
    - Standards, systems and procedures for assessing, avoiding, eliminating, controlling and minimising health risks;
    - Regulations on any aspect of health; and
    - Collecting, processing and distributing health in the mining industry.

- The Safety in Mines Research Advisory Committee as well has the responsibility to advise the Council on:
    - Criteria for determining the funding of health and safety research;
    - The need for determining the funding of health and safety research;
    - Research projects, including priorities of projects, cost, assessment, ratification and execution;
    - Communication and publication of research results; and
    - The management of the cost of the overall programme.

- The Safety in Mines Research Advisory should prepare:
    - A review of health and safety performance in the different mining sectors;
    - An evaluation of the research proposals made by the Council or a Committee of the Council;
    - The focus of health and safety research and priorities for the different mining sectors; and
    - An estimate of the cost of the programme.

Section 25 of the *Mine Health and Safety Act No. 29 of 1996* requires the appointment of safety representatives and committees who are elected from among the employees (RSA 1996:34). The duties of safety representatives and the committees are:

- To represent the employees on all aspects of health and safety;
- To direct employees to leave any working place that appears to pose a serious danger to health and safety of the employees;
- Identify potential hazards and risks to health and safety;
- Inspect working places with regard to the health and safety of employees; and
- Investigate complaints relating to health and safety at work and participate in health and safety consultations as well as any health and safety inspection (RSA 1996:34).

Through this Act the government requires the mine workers to participate in all aspects of safety including the development of safety standards and procedures to ensure that the employees' rights are understood and observed including the right to refuse dangerous work.

2.4.3. Safety Regulations related to mine safety

Section 98 (1) of the *Mine Health and Safety Act No. 29 of 1996* (RSA 1996:79) gives the Minister, after consulting the tripartite institutions in terms of 2.5.2.5 of Chapter 2, by notice in the Gazette to make regulations in order to ensure safety in the mining industry regarding:

(a) health and safety of persons at mines;

(b) health and safety standards, codes of practice and the provision of protective clothing, equipment facilities in connection with health and safety at mines;

(c) the performance of work by employees exposed to a health hazard and the measures to eliminate, control and minimise health risks;

(d) health and safety management systems at mines;

(f) the powers, duties, functions and responsibilities of employees at mines;

(g) the issuing of permits to the use of machinery, equipment and material at mines and the accreditation of persons to test machinery, equipment and material for these purposes;

(h) the conditions under which machinery, equipment or material may be erected or used at the mines;

(i) the elimination, control and minimisation of health and safety hazards;

(j) requirements for the use, handling, processing, storage, transport and disposal of hazardous substances used in the mining process and waste produced at the mine;

(k) the transport, handling, storage and use of explosives and the mixing of substances to make explosives at a mine;
(l) the protection of equipment, structures, water sources and the surface of land;
(m) the conditions in which equipment, structures, water sources or the surface of land may be used, and the prohibition on, or restriction of, erection of equipment and structures and the use of water sources or the surface of land in the vicinity of the working places at a mine; and
(n) the making safe of undermined ground and of dangerous excavations, tailings, waste dumps, ash dumps and structures of whatever nature made in the course of prospecting or mining operations or which are connected with those operations (RSA 1996:79).

Since the enactment of *Mine Health and Saf*ety *Act No. 29 of 1996,* twenty-three regulations have been promulgated to realise the provisions of the Act, namely:

1. Appointments and Administration;
2. Duties and Responsibilities;
3. Electricity;
4. Explosives;
5. Fires and Explosions;
6. Health and Safety Representatives and Committees;
7. Inspectorate of Mine Health and Safety;
8. Machinery and Equipment;
9. Mine Environmental Engineering and Occupational Hygiene;
10. Miscellaneous and General Provisions;
11. Occupational Medicine;
12. Offshore Installations;
13. Outlets, Ladder ways and Travelling Ways;
14. Protection of the Surface and the Workings;
15. Qualifications and Competencies;
16. Rescue, First Aid and Emergency Preparedness and Response;
17. Surveying, Mapping and Mine Plans;
18. Tripartite Institutions;
19. Underwater Mining;
20. Definitions;

21. Forms;
22. Schedules; and
23. Reporting of Accidents and Dangerous Occurrences (Acts online 2012).

In accordance with the above-mentioned regulations the government provides the dos and the don’ts of the mining industry. Through the regulations the government instructs the mining companies to have a code of practice in a form of safety control mechanisms in order to make sure that the environment is kept safe; activities are performed safely and ensure the safety of all employees. Through the above regulations, the organisations are provided with detailed instructions as to what should be done to eliminate, mitigate and control hazards and ensure safety.

It is evident that for decades mine workers have been exposed to unsafe working conditions and suffered fatal and crippling injuries as a result. The apartheid era made working in the mines even more difficult especially for the black mine workers. The well-being of black workers was not a priority but profit for the mining companies certainly was. Although there was a legislative framework in place at the time - *The Mines and Works Act No. 27 of 1956* and the *Occupational Diseases in Mines and Works Act No. 78 of 1973* - to ensure the safety of workers in the mines, the colonial laws were consolidated into the Act and therefore the Act did not serve its purpose. Democracy, in 1994 brought about the new laws which ensured that all mine workers are safe at all times while at work and these laws have resulted in a reduction in fatalities. However, mine workers still die and suffer crippling injuries in South African mines due to the ignorance of mine workers. On the other hand accidents in the mines are due to the failure of mining companies to have safety control mechanisms in place and to ensure safety according to the requirements of the Acts and Regulations mentioned above. Although accidents can happen anywhere and at any time, the government of South Africa believes that accidents are preventable provided mining companies abide by the legislation and have safety control measures in place.

2.5. MINE ACCIDENTS AND INJURIES WITHIN THE MINING INDUSTRY

Mining is considered to be a dangerous occupation based on the fact that mine workers have to face relatively hazardous work environments due to heat and gases that they are exposed to compared to workers in other industries (Kecojevic, Komljenovic, Groves & Radomsky 2007:865). Mine workers' skeletons litter the mines of South Africa. The bodies of many of those who died underground were never found or could not be recovered, and the families were never provided with the opportunity to bury their loved ones decently and according to African rituals and traditions. In the worst catastrophes, the bodies recovered from the mines were often unidentifiable and the families could not recognise the bodies. This was unfortunate indeed considering the risk of burying the wrong bodies if they insisted on getting the remains for ritual burials (Baleni 2011). In 1996 at Rovic, twenty miners died and only four bodies were recovered while at Vaal Reefs 104 men died underground in 1995 and some of the bodies were so mutilated that it was difficult for women to identify their own husbands. However; everyday mine workers continue to risk their own lives and limbs by going underground into 'mazes of gold'. In the mines one can die at any time during the eight hours due to an earth fall, a gas explosion or extreme heat. However, due to the hard life of remote villages where unemployment and hunger are the norm, working in the mines is an obligation (Baleni 2011). Unfortunately after accidents thousands of miners are sent home every year because of inability to perform duties after sustaining injuries (Ndlovu 2008).

2.5.1. Causes of mine accidents and injuries

Biyase (2011:10) declared that the accident that claimed two lives at Harmony Gold Unisel, in the Free State and at the Northern Platinum mine in Limpopo in 2011 could have been prevented. The Department of Mineral Resources (formerly Department of Minerals and Energy) insisted that the mining companies should implement an automated model which prevents wagons from running if there is a problem. However, these calls were disregarded by the mining companies due to the implementation costs involved (Kohler 2010). Unfortunately safety is just talked about in South Africa because it costs money and to avoid these costs, mine owners and operators find ways to avoid and defeat safety legislation (Laurence 2005:41). Accidents and loss of life in South African mines are due in significant measure, to carelessness on the part of mining companies (Eweje 2005:170). This was affirmed by the safety audit conducted in 2009 to determine the levels of compliance of high risk mines within South Africa with the legislative requirements as set out in the *Mine Health and Safety Act No. 29 of 1996*. The audit was prompted by an incident that took place in 2007 where 3200 miners were trapped underground for 42 hours (Furter 2009).

The findings of this audit did not show good results with regard to safety compliance by the mining companies. The overall results of the audit showed only 68% compliance with regard to safety risk management and 66% with regard to occupational health and safety training. The overall score achieved by the mining industry in South Africa was 60% compliance with the relevant requirements of the *Mine Health and Safety Act No. 29 of 1996* (Sonjica 2009). These are the results of 600 high risk mines that the former president Mr. Thabo Mbeki ordered to be audited (Makhafola 2007).

This clearly demonstrates that there is lack of safety within the mining industry in South Africa either the mining companies are trying to avoid the implementation costs of safety measures or the employees are simply ignoring or violating the safety rules. Ndlovu (2008) stated that the mine workers have been working very hard to persuade the employers to provide safety education to the workers however this has been difficult as some mining companies still do not even provide basic personal protective equipment (PPE) for the employees. Moreover, there was confirmation by Baleni (2011) who declared that,

"….It has become part of conventional wisdom for both the boardroom news and the underground workers that pillar mining is the most dangerous enterprise which resulted in the death of 437 miners in 1960 at Coalbrook mine (Van der Merwe 2006:857). Nevertheless, the bosses continue to use pillar mining without taking all the necessary precautions to ensure miner safety, in spite of the obvious and inherent danger to human life".

In July 2010, a rock fall at the Marikana mine claimed six lives. Due to this incident, mining companies were instructed to evaluate the codes of practice regarding all operations that use board-pillar mining and put in place the revised standards and procedures. Yet the mines complained about the implementation costs and insisted that the directive would have a negative impact on production and profit. Based on this argument, mines were allowed to come up with flexible safety solutions and present them to the inspectorate while operations continued as usual (Kohler 2010). This incident attracts attention to the responsibility that mining industry must take to improve the safety record. The unwillingness of mining companies to take into account all possible options at their disposal to improve safety performance must be addressed. This also highlights the inadequate government arsenal to improve and enforce adherence to safety standards (Kohler 2010). The report of the Leon commission in March 1995 gave the mine workers hope as the government decided that the recommendations of the commission must be put into practice immediately to make sure that the safety of employees in the mines becomes a priority. Again these recommendations were ignored until the Vaal Reefs disaster where 104 mine workers died underground due to the owners not implementing the recommendations of the commission (Baleni 2011). Some mining companies do comply with safety requirements as the audit report indicated but accidents still occur. Patterson and Shappell (2010:1579) reminded us that nearly 85% of all mining accidents are caused by human error. That is, people failing to follow the applicable rules and procedures and getting involved in unsafe acts. Patterson and Shappell (2010:1379) describe human error at four levels:

- The unsafe acts of operators;
- Preconditions for unsafe acts;
- Unsafe supervision; and
- Organisational influences.

2.5.1.1. Unsafe acts of operators

Operators become involved in unsafe acts because they do not have the skills, knowledge or training that amounts to a personal readiness to perform certain tasks safely. The operators must be equipped with skills and trained in order to gain knowledge in relation to the procedures to be followed in performing the tasks, to enable them to recognise hazards associated with their tasks, and to enable them to take appropriate actions to eliminate or mitigate any potential hazard that may arise during the performance of tasks (Patterson and Shappell. 2010:1382). Another principal cause of accidents is the carelessness of miners which includes deliberate violation of applicable rules and set procedures. For example, miners carrying too much powder into the mines, using the wrong oil in their lamps, failing to timber properly their working places and careless handling of explosives (Laurence 2005:41).

2.5.1.2. Preconditions for unsafe acts

This refers to underlying hidden conditions that encourage the employees to be involved in unsafe acts. These conditions include, for example, distractions and mental fatigue, environmental factors like weather and visibility, and resource management as in failure of leadership (Patterson and Shappell 2010:1384).

2.5.1.3. Unsafe supervision

Unsafe supervision refers to inappropriate or poor supervision which fails to correct unsafe behaviours where the supervisor wilfully disregards rules and regulations in order to meet production targets. Failure to provide professional guidance in relation to the performance of tasks in a safe manner and intentionally encouraging the workers to take short-cuts puts workers at unacceptable risk as workers do not know what is expected of them (Lenne, Salmon, Liu & Trotter 2011:2).

2.5.1.4. Organisational influences

This refers to the encouragements that come from higher management in relation to production. Workers are pressured to meet production targets and due to this pressure they ignore safety rules and get involved in accidents. As a result this impacts negatively on the workers' perceptions which may lead to job dissatisfaction, poor management commitment, time pressures and concerns with policies and procedures which may result in work injury and the propensity to commit violations (Lenne *et al.* 2011:2). According to Seo (2005:191) there are companies where the culture allows employees to take risks, therefore the attitude towards accidents is that,

> "….accidents just happen and there is nothing we can do about it".

This attitude is not encouraging the employees to do their best to avoid accidents hence it is not conducive to an effective safety culture.

2.5.1.5. Other causes of accidents include the following:

- The fatal accidents and injury rates especially in South Africa are influenced by the tremendously harsh mining conditions due to the depth (over 3000m in some gold mines). Rock bursts increase the fatality rate to three times the average at the depths below 3000m (Eweje 2005:170). The workforce operates in confined spaces, poisonous blasting fumes that lead to employees inhaling chemical substances, coal dust that is extremely explosive and rock temperatures that often exceed 50˚C all add to the danger of the situation. Regardless of all these, the research conducted by Eweje (2005:172) found that the miners were not using the protective equipment.

- The mining industry in South Africa is known to be production and profit focussed. These high production targets put a lot of pressure on the employees and time constraints are found to lead to the violation of the safety legislation and result in a decrease in the safety levels of operations. Employees have strict targets to meet within specified timelines, which might encourage the miners to take shortcuts and thereby jeopardise safety compliance (Masia 2010:31). Companies which are production oriented do everything possible to ensure the achievement of those targets and in the process, the employees ignore safety procedures. At times, the authoritarian management style and a 'don't care' attitude that mine workers are subjected to from the managers as well as the high focus on production have also been found to contribute to employee job insecurity and the taking of risks. These inherent mining characteristics are found to remove the employees' focus off the safety requirements thereby contributing to workplace accidents and incidents (Masia 2010:32). According to Moller (2003:20) these performance pressures lead to job insecurity and stress which are believed to have a negative impact on safety compliance. In response to the tension between production and safety compliance on 2 November 2007, the National Union of Mine Workers and the miners took part in a one day strike to protest against "death in the line of duty" within the mines. The marchers declared that "safety is a human right" (Beresford 2007).

- The *Mine Health and Safety Act No. 29 of 1996* section 25 requires the election of health and safety representatives by workers to participate in the Mine Health and Safety Council (29/1996). But the opinions of these representatives are often ignored and therefore fail to ensure the safety of employees through the implementation of safety measures in order to moderate or lessen danger and hazards in the mining industry (Hermanus 2007:532).

- There is a high number of contractors within the mining industry competing for work. This makes it difficult for these contractors to focus on occupational health and safety and still be able to quote competitively for work (Hermanus 2007:532).

- Small companies within the industry lack the resources that their larger companies have to the health and safety of their employees by putting methods and controls in place that will ensure risk management (Hermanus 2007:532).

2.5.2. South African mine accidents and injuries

Regardless of the South African safety legislation that provides guidelines to ensure mine safety, there has been no real improvement that has been achieved in accident prevention in South African mining industry. Matomela (2011) stated that there has not been a major improvement in safety performance within the South African mining industry. Although the statistics indicate a drop in injury and fatality rates, the decrease is not significant. This fact is supported by an analysis of the accident statistics of the South African mining industry which follows later in this chapter.

The South African mining industry has long been categorised by a frightening accident rate. In order to reduce the number of miners dying and getting injured at work, the *Mine Health and Safety Act No. 29 of 1996* was put in place. According to the Minister of Mineral Resources, Mrs Susan Shabangu (2012) there is lack of compliance with the requirements of the Act in the South African mining industry. The figures released by the Minister highlighted that there has been a decrease in mine-related fatalities but it was stated that the decrease was due to safety stoppages. Baleni (2011) acknowledged that the *Mine Health and Safety Act No 29 of 1996* in the last 16 years was able to give the miners rights in relation to the provision of a safe working environment which has resulted in injury and fatality reduction within the industry as indicated in *Table 2.3*. However, the reduction in fatality and injury rates has been slow due to the labour intensive nature of the mining industry and its illiterate and innumerate work force.

Table 2.3: Fatality and injury rates in South Africa

YEAR	NUMBER OF FATALITIES	FATALITY FREQUENCY RATE		NUMBER OF INJURIES	INJURY FREQUENCY RATE	
		Per 1 000 persons at work	Per million hours worked		Per 1 000 persons at work	Per million hours worked
1994	482	0.95		7934	15.71	
1995	533	1.02		7717	14.76	
1996	463	0.94		7426	15.00	
1997	415	0.86		7100	14.67	
1998	366	0.85		6059	14.12	
1999	309	0.76	0.34	5488	13.42	6.10
2000	285	0.72	0.33	4733	11.93	5.26
2001	288	0.75	0.34	4728	12.34	5.61
2002	290	0.75	0.34	4461	11.52	5.24
2003	270	0.65	0.29	4301	10.32	4.69
2004	246	0.56	0.25	4268	9.66	4.39
2005	202	0.45	0.20	3985	8.92	4.06
2006	200	0.44	0.20	4169	9.10	4.14
2007	220	0.45	0.21	3861	7.96	3.62
2008	171		0.15	3750		3.34
2009	168		0.16	3672		3.43
2010	127		0.12	3436		3.22
2011	123		0.11	3299		3.00
2012	112		0.10	3377		3.03
2013	93		0.09	3126		2.88

Sources: Chamber of Mines of South Africa – Mining: an in-depth discussion of mining issues in South Africa (2010:60) and (2013:28). Department of Minerals and Energy (2008:20). Annual Reports of the Department of Mineral Resources (2010:72), (2011:61) and 2013:69).

The first column indicates the year for which the statistics are reported. The columns titled fatalities and injuries reflect the number of mine workers injured and fatally injured at work. Fatality and injury rate indicate the number of fatal injuries per 1 000 employees at work. In South Africa, the rate of per 1 000 employees at work has traditionally been used. These rates are calculated by means of the following formula:

$$\text{Injury/fatality rate} = \frac{\text{No. of injuries/fatalities} * 1\,000}{\text{No. of employees at work}}$$

Internationally, the trend is towards a million-hours worked. Hence, in 1999 the million hour work measure was introduced for international benchmarking purposes. Fatality rate which is generally referred to as Fatal Injury Frequency Rate (FIFR) is calculated as follows:

$$FIFR = \frac{\text{Number of Fatalities X 1million hours worked}}{\text{Total hours worked}}$$

The formula is the same for the injury rate (IFR) (Department of Minerals and Energy - Mine Health and Safety Audits 2008:19) as thus:

$$FIFR = \frac{\text{Number of Injuries X 1million hours worked}}{\text{Total hours worked}}$$

The benchmarks are used to compare the performance of South African mine industry with other countries – Australia, United States of America and Canada as far as safety is concerned. This is shown in *Figure 2.1*, the line curve shows where South Africa is with regard to fatalities and the bars indicate the trend of Canada, Australia and Unites States of America (USA) safety performance. It also designates where South Africa should be in order to be in the same position with its counterparts in the mining industry. The Chamber of Mines uses 2003 as the benchmark year as it was agreed in the same year (2003) by the unions and the government that by 2013 South African mine deaths should be comparable to international benchmarks. This means that South Africa should be comparable as far as injuries and fatalities are concerned, with Australia, Canada and the USA (Jones 2011). The chamber remains committed to the ideal of zero harm in the mining industry. South African fatalities are currently three times those of Canadian and Australian mines (Chamber of mines – Mining: an in-depth discussions of mining issues in South Africa 2009:12). In order for South Africa to reduce its injury and fatality rates it has to improve by at least 20% per year to achieve the average safety performance of USA, Canada and Australia by 2013 (Sibiya 2011). Nonetheless Dr. Phillip Frankel, the author of the publication on mine safety - *Falling Ground* -is doubtful and believes that South African mining industry is not going to attain that 2013 target let alone sustain it (Creamer 2010).

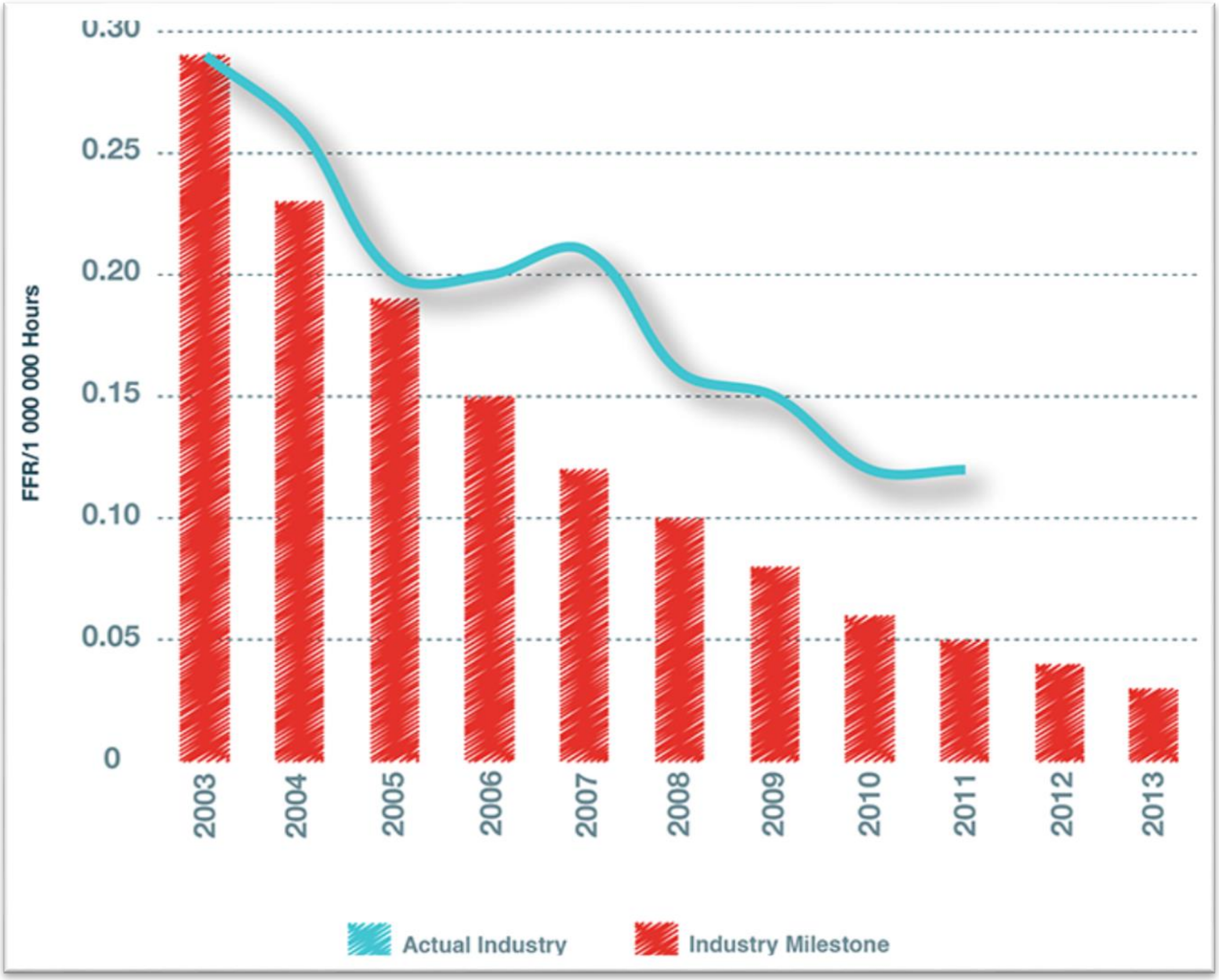


Figure 2.1: Fatality Frequency Rate Graph (2011)

Source: Chamber of Mines of South Africa– Safety and sustainable development (2011:1).

Table 2.4 shows South African mine fatalities as compared to the fatalities of its counterparts in the same industry. Mine workers in South Africa are 4-5 times more likely to be involved in fatal accidents than in USA, Australia and Canada (Hermanus 2007:532). Ural and Demikol (2008:1017) declared that USA started showing progress with regard to safety since the beginning of 20th century due to mine safety legislation and enforcements, new technology and equipment as well as the change in mining methods. The strengthening of the legislation increased the rights, hence the drop in mine fatalities from 272 in 1977 to 86 in 2000 (USA Department of Labour

2013). While in Australia besides the laws that regulate the health and safety of workers, the codes of practice were developed to include risk assessment and management (Joy 2004:311).

*Table 2.4**:** Mine fatalities in South Africa compared to USA, Canada and Australia*

YEAR	NUMBER OF FATALITIES IN SOUTH AFRICA	UNITED STATES OF AMERICA	AUSTRALIA	CANADA
2001	288	72	15	41
2002	290	70	7	29
2003	270	56	12	25
2004	246	55	12	31
2005	202	58	10	23
2006	200	73	11	36
2007	220	67	14	4
2008	171	53	4	8
2009	168	35	18	
2010	127	71	7	
2011	124	37	7	
2012	112	36	2	
2013	93	42	6	

Sources: Mineral Council of Australia (2011:16) and (2012:29). United States Department of Labour (2012). International Labour Office Bureau of Statistics (2012).

Mining companies in Australia have shown their willingness and commitment to safety by going beyond regulatory expectations to develop procedures to ensure safety of employees. This was prompted by the explosion in Queensland at the Moura Mine in 1994 that claimed 11 lives and the flooded mine shaft at Gretley Colliery in 1996 that killed four men (Mitchell, Driscoll & Harrison 1998:107). Risk assessment and management are the controls or management strategies used to eliminate, mitigate or tolerate the identified risk profiles. These may include physical changes of the environment, equipment or mine designs and layouts to achieve the anticipated risk reduction (Hebblewhite 2009:14). The risk-based management was established and instigated in the early 1990s in Australia as it was found to be effective. Due to its potential, it was used as an indispensable basis of all mining legislation (Poplin, Miller, Ranger-Moore, Bofinger, Kurzius-Spencer, Harris & Burgess 2008:1201). This was also highlighted by the United States Department of Energy that for the mining industry to be successful, it has to take into account risk management and consider it as one of the business objectives (Komljenovic *et al.* 2008:793).

In Canada, Australia and USA the Workplace Risk Assessment and Control (WRAC) tool was adopted to ensure safety. WRAC has a proven track record in USA and Canada and it can therefore be contended that it is the advantageous risk assessment tool that has helped to make the Australian mining industry one of the safest industries in the world (Department of Employment Economic Development and Innovation 2010:11-15). The South African mining industry established and put into practice the Hazard Identification and Risk Assessment (HIRA) which is the logical way of ascertaining and authenticating significant risks. The outcomes from HIRA are the inputs for the risk treatment process which is part of a broader risk management process. However, the HIRA programme does not address all aspects of the risk management process (Komljenovic, Groves & Kecojevic 2008:794).

Another concern in South Africa is that the mining industry is profit driven and this becomes a challenge for the government to improve compliance to safety legislation. This was stated by Kohler (2010) after the death of six mine workers due to the rock fall at Marikana mine in Rustenburg in July 2010 after the mining companies complained about a review of the codes of practice and the adoption of revised safety standards and procedures. The mining companies claimed that the instruction would negatively impact on the productivity and the profitability and therefore result in job losses. The government reconsidered its instruction and allowed the mines to provide alternative and appropriate safety solutions while the mining companies were permitted to continue with the mining operations as before.

From the above, it is evident that mining industry in South Africa is far from reaching its target of ensuring safety and preventing injuries as the mining companies are profit-oriented. This therefore results in the lack of commitment since dedication to safety has a direct financial impact. This indicates that the government must forcefully extract commitment. However, the government's tools are fairly weak; the government is too lenient when it comes to enforcement. The government's arsenal and safety inspectorate must be strengthened (Kohler 2010). The employees as well are not doing enough to ensure safety as human error was found to be the main cause of accidents within the companies that are compliant. Accident statistics in South Africa show a downward trend with regard to mine fatalities and injuries since 1994 yet, the health and safety of mine workers still remains an issue of grave concern. The statistics do show a decline as stated earlier based on the fact that the mining industry used to have more than 500 fatalities per year before 1994. Therefore; after 1994 the new legislation brought about improvements in the mining industry in relation to fatalities in South Africa. Although the number of fatalities and injuries has decreased; the mine workers are still dying and this is against the fundamental right to life that the mine workers deserve to have, "One death is one too many" (Shabangu 2011).

2.6. COST IMPLICATIONS OF MINE ACCIDENTS AND INJURIES IN SOUTH AFRICA

Occupational accidents and injuries have enormous social and economic repercussions for the injured employee, their dependents and communities as well as the companies (Hermanus 2007:531). The implications are in the form of indirect and direct costs to the companies and the society at large. The total cost of occupational accidents and injuries is estimated at between 1 and 3% of Gross Domestic Product. Direct costs include medical expenses for the injured, property damage and the costs of loss of production due to safety stoppages (Hermanus 2007:531). Indirect costs include all the costs associated with care-giving, the cost of livelihoods lost, loss of income to dependents, cost of lost time of injured employees, damage to property, machinery and tools, loss of reputation and withdrawal of capital investment from the mining companies (Shalini 2009:974). Ural and Dermikol (2008:1017) are of the view that cost plays a vital role in the provision of safety measures. Apart from incurring costs, mining companies are at the risk of having the operations halted according to section 54 of the *Mine Health and Safety Act No. 29 of 1996* if the companies do not adhere to the legislative requirements (Hermanus 2007:531).

In 1995 the Leon Commission of Inquiry (Leon 1995:27) concluded that mine workers were exposed to dust however, this has remained unchanged in the South African mining industry for the past 50 years. Over the years; safety performance in the South African mining industry has got better but not at the same rate as in other mining industries like Australia, Canada and USA (Hermanus 2007:532). These countries have the lowest mine fatality record globally and the safety performance of South Africa should have been equivalent to the international benchmarks by 2013 and should have reached its safety target of zero harm by 2013 (Vogt 2011:231). At this point therefore it is necessary to compare the legislative framework of these countries with South African legislative framework. However, only one country will be used for comparison purposes.

Among the three countries, Australia and Canada have the lowest fatality statistics as indicated in *Table 2.4.* To determine whether to use Australia or Canada, the legislative framework of these two countries were compared. The comparison revealed that the work health and safety in Australian mining industry is controlled by states or territories, New South Wales, Queensland and Western Australia which have different regulations (United States Department of Labour 2013). The Canadian mining industry is governed by a combination of federal laws and laws of provinces or territories with the *Canada Labour Code* as the principal federal law. The health and safety laws adopted by provinces and territories are similar to the *Canadian Labour Code* (United States Department of Labour 2013). Hence comparison will be made between South African Safety Acts and Regulations and the *Canada Labour Code* which provides general Safety Regulations applicable to the entire mining industry in these countries. Furthermore, this comparison was encouraged by the fact that Canada is considered to be the global leader in health and safety standards that is why its mining industry is considered to be safer than in other countries (Baird 2009). At this point the Canadian Mining Industry and its legislative framework will be looked into.

Based on the above information, it is apparent that some of the working conditions in the mining industry have remained unchanged and the mine workers have been exposed to unsafe working environments for decades. As a result mine workers get injured and even die in the mines. These accidents and injuries have a negative impact on the country, its economy, the mining companies due to costs incurred, the families of the deceased and on the injured mine workers.

2.7. CANADIAN MINING INDUSTRY

There are more than 800 mines across the country of Canada, employing more than 388 000 workers and the majority of these mines are underground. Canada ranks first in the world for production of potash and uranium. It is among the top five countries for the production of nickel and diamonds, contributing nearly 5% while coal contributes about $5.2 billion to the country's Gross Domestic Product. Coal production in Canada delivers major economic and social benefits to the Canadian economy and it is the largest contributor to Canada's economy producing more than 60 different minerals and metals. Over the past century, the mining industry in Canada has moved from what was once a highly physical and often dangerous occupation to a sophisticated industry.

It is the lowest in worker accidents for major industries. This is due to major advances in mine engineering, strict training and safety standards, rigorous and safe operating practices and again it makes use of automated mining processes. Hence, it has become one of the safest industrial sectors in Canada (Swedish Trade Council in Canada 2006:51). All these can be related to the legislative framework that Canada has in place with regard to safety.

2.7.1. The Canadian mining legislative framework

The Canadian mining industry is governed by the *Canada Labour Code* which incorporates the following Regulations that are related to the mining industry:

- The *Canada Occupational Health and Safety Regulations*; and
- The *Coal Mining Occupational Health and Safety Regulations*

2.7.1.1. Canada Labour Code

The *Canada Labour Code* is a broad piece of legislation promulgated in 1985, last amended on the 1st January 2010 and in force up to 17th June 2015. It covers industrial relations (section 8), that is:

- The certification of unions, management relations, collective bargaining and unfair labour practices;
- Work place health and safety; and
- Employment standards, including general holidays, annual vacations, working hours, unjust dismissal, minimum wage, layoff procedures and severance pay (Canada 1985:90).

2.7.1.2. The Canada Occupational Health and Safety Regulations

These Regulations are current to the 17th June 2015 and were last amended on the 30th September 2011. These Regulations (section 122) provide standards and procedures to be followed by the employers and employees in different industries with regard to the provision of safe working conditions *inter alia:*

- Handling of explosives, equipment and tools;
- Provision of safe temporary and permanent structures;
- Electrical safety;
- Lighting, sound levels and elevating devices; and
- Safety occupancy of the workplace (Canada 1985:97).

2.7.1.3. The Coal Mining Occupational Health and Safety Regulations

These regulations were in force up to the 17th June 2015 and were last amended on the 15th June 2006. The following are the major contents of the Regulations specifically for coal mining (section 90 - 97):

- Duties of employers and employees in coal mines;
- Establishment of the coal mining safety commission;
- Permission of inspections;
- Submission of all plans and procedures to the Coal Mine Safety Commission and conforming activities to those plans;
- The employers to obtain approval for operating any machine for which no safety standards exists;
- The right of the employee to refuse to operate a machine or anything that the employee considers to be dangerous; and
- Employees' right to complain (Canada 1985:157).

2.7.2. Comparison of the *South African Mine Health and Safety Act No. 29 of 1996* and the *Canada Coal Mining Occupational Health and Safety Regulations*

Under the *Canada Labour Code* there is a comprehensive document that provides detailed guidelines with regard to the procedures to be followed especially in coal mining. This is because historically no other occupation has been as dangerous as mining coal, declared Margolis (2010:417). Hence Canada has legislation in place just for mining coal. All the Regulations are compiled under one document and therefore it is user friendly as all the information with regard to labour is contained in one Act. The *South African Mine Health and Safety Act No. 29 of 1996* states that the employers and employees should ensure as far as reasonably practicable that the work place is safe and the work is done safely while the *Canada Labour Code* under the *Canada Coal Mining Occupational Health and Safety Regulations* provides detailed procedures as to what should be done and how in relation to the following:

- Storage - handling of explosives and detonators;
- Safety occupancy of the work place;
- Underground transportation and hoisting;
- Ventilation; and
- Explosion and fire protection.

If the procedures are not provided under the *Canada Occupational Health and Safety Regulations* or the *Canada Coal Mining Occupational Health and Safety Regulations*, the employer must write down the procedures and submit the copy to the Coal Mine Safety Commission for approval before implementation. In the case where the employer wants to change the procedures or there is equipment to be installed, for example a booster fan, a survey must be carried out and the copy of the survey must be submitted for approval before installation. This ensures that all mines provide the same level of safety and it is easy to control and manage safety if the same procedures are followed. The risks cannot be completely eliminated but the legislation indicates the type and the conditions of protective clothing to be provided to the employees and how it should be used. The Canadian Regulations were up to date as at June 2012, that is they included all the repealed, amendments and replacements to the Regulations until June 2012. While the *Mine Health and Safety Act No. 29 of 1996* in South Africa places the responsibility on the person who designs, manufactures, repairs, erects or installs any article for use in the mine. It is their responsibility to ensure that the article is safe and without risk to health and safety when used appropriately (RSA 1996:25).

In closing, it is evident that Canada has been able to provide a safe mining industry because of its strict training standards, step-by-step procedures and approval of all safety procedures of different organisations not incorporated in the *Canada Labour Code*. As a result, the mining industry in

Canada has become the safest mining industry in the world; the industry that has very few work-related accidents and injuries.

2.8. SIGNIFICANCE OF SAFETY REGULATIONS FOR MINING ORGANISATIONS

For years, in different countries work-related accidents have been considered to be a disastrous and inevitable condition of work. However, attempts were made to improve safety in the workplaces through legislation. The safety legislation was criticised and considered to be unsuccessful due to unwanted side effects such as reduced production and competitiveness. Although gains for adopting safer practices were identified, they were considered not substantial enough to encourage safety investments (Jayasinghe-Mudalige& Henson 2007:1370). It was identified in the study of Jayasinghe *et al.* (2007:1368) and consistent with Neuman and Nelson (1982:196-198) that measures for safer mining resulted in slower mining and reduced productivity. Smaller companies had to close down as mining was no longer profitable. The safer practices resulted in more than a 30% drop in production per person. The study stated that the Act resulted in a productivity decline of 1.75 tonnes but brought about safer working conditions. The Act also resulted in a 9% reduction in fatality rate. This is because fatal accidents were replaced by non-fatal accidents after implementation of the Act. But how does this indicate a gain? Is it a gain to have a live, crippled miner instead of a dead one? Feng, Jiang, Weisong, Zetian and Xiaoshuan. (2009:920-921) also confirmed that legislation resulted in a decline in productivity as resources were diverted from output-producing to accident-reducing activities. It is therefore believed that implementation of safety systems raises overall costs with increased production costs after implementation as safety costs are substantial.

The safety costs are divided into two categories: the cost incurred to ensure safety and non-safety costs. Safety-producing activities include the safety measures put in place to reduce risk as well as training with regard to safety measures and personal protective equipment (Caputo, Pelagagge & Palambo 2011:1). Non-safety costs are the costs incurred due to lack of safety such as accidents and incidents and are indicated as follows:

- ***Loss due to the injured person*** – When employees get injured at work, this results in organisations incurring losses as the injured employees have to be compensated as well as the payment of wages to idling employees whose tasks depend on the output of the injured person. Further losses are incurred when the employee returns to work after injury. The employee has to be paid a full salary or wage regardless of the inefficiency of the recovering employee (Tang, Lee & Wong 1997:178).

- ***Loss due to medical expenses* –** Accidents lead to accumulation of costs due to the payment of medical expenses of the injured workers (Tang *et al.*1997:178).
- ***Fines and legal expenses* –** When accidents results in fatalities, the organisations face prosecution or fines that will be imposed by the court if the organisation is found to have been negligent (Tang *et al.* 1997:178).
- ***Loss of time of other employees* –** At times employees have to abandon their duties when accidents occur in order to assist the injured worker. This may include carrying out of works related to the accident such as reporting the accident and investigations (Tang *et al.* 1997:178).
- ***Equipment or plant loss* –** Accidents may cause damage to plant and equipment (Tang *et al.* 1997:178).
- ***Loss due to idle machinery or equipment* –** After an accident, the equipment of the injured worker will lie idle as well as the equipment of the other employees who provide assistance to the injured worker (Tang *et al.* 1997:178).
- ***Loss of production* –** After a fatal accident, investigations have to be carried out in order to establish the cause of the accident as a result production will have to stop while these investigations are carried out (Tang *et al.* 1997:177-178).
- ***Closure of business operations* –** If the organisation has been negligent especially in the mining industry, section 54(1) (a) of the *Mine Health and Safety Act No. 29 of 1996* states that the inspector may give any instruction necessary to protect the health and safety of persons at the mine including but not limited to an instruction that operations at the mine or a part of the mine be halted (RSA 1996:56).
- ***Impact on morale* –** An accident may affect the workers' morale and motivation, causing absence from work, sluggishness and a higher rate of worker substitution. Workers may

also demand salary increases for endangerment in the working place (Gaviours, Mizrahi, Shani & Munchuk 2009:436).

The study conducted by Haslam, Haefeli and Haslam (2010:484) concluded that although it was acknowledged that the cost of implementing safer practices according to the requirements of health and safety legislation was considered to be high, it was established that investing in health and safety moderates injury and fatality costs. The organisations under study confirmed that cost reduction was the only one that encouraged commitment to health and safety. The study acknowledged that if the health and safety systems are effective in order to reduce occupational injuries and illnesses, indirect costs and direct costs in relation to accidents and injuries will diminish. The findings of this study demonstrated that organisations were motivated to implement safer practices in order to reduce accident costs which are considered to be the cost of running the business and therefore of increasing profitability (Haslam *et al.* 2010:488).

Kecojevic *et al.* (2007:865) are of the view that the severity and the frequency of mining injuries, illnesses and fatalities are among the costliest. To ensure that organisations invest in health and safety measures, the government of South Africa has increased fines from R200 000 to R1 000 000 that will be used as an incentive for mine owners to adopt safer practices and invest more in health and safety (Sonjica 2008). The only way that mines can follow in order to achieve a better competitive advantage is to control the cost caused by mine accidents. This can be achieved through the implementation of safety measures which have been proven to be more profitable through accident and injury cost savings. Should the safety measures be implemented, a great number of accidents could be prevented along with the costs associated with them as indicated in *figure 2. 2* below.

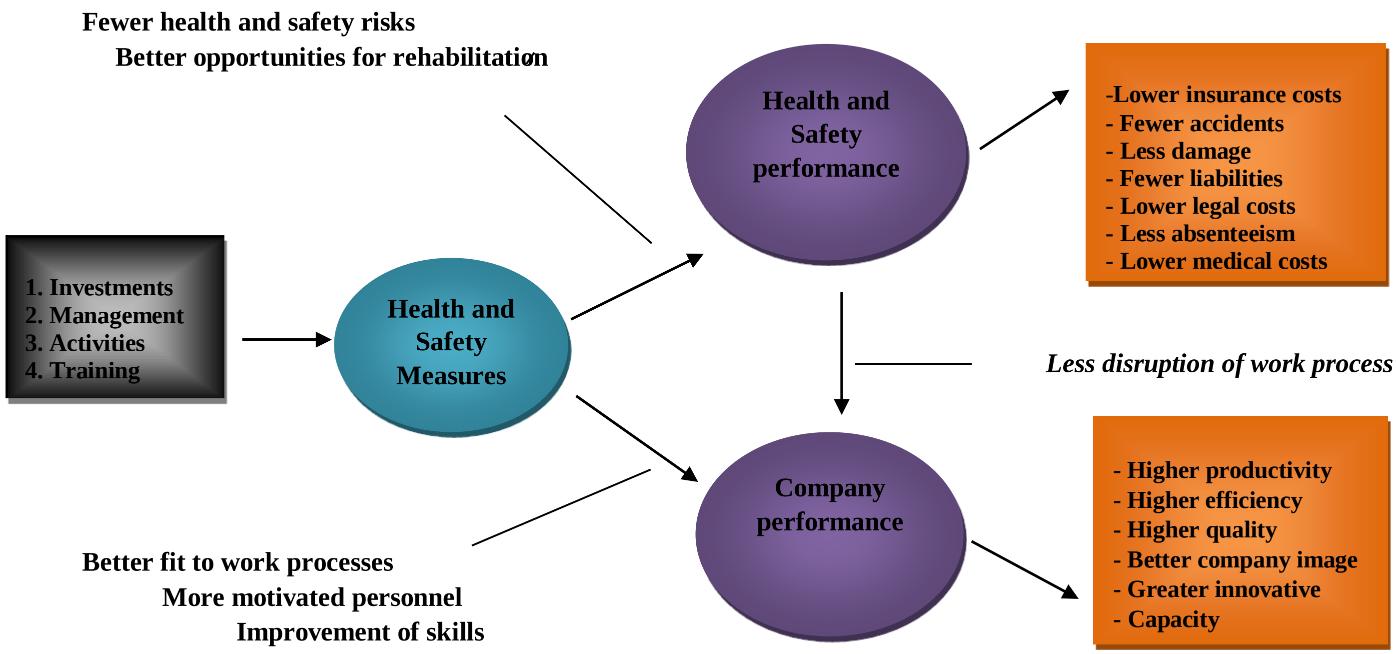


***Figure 2.2**: Economic effects of health and safety at company level.*

Source: Fernandez-Muniz, Montes-Peon and Vezquez-Ordas (2009:982).

From the above information, it can be concluded that although safer mining results in slower mining and requires resources to be converted to the implementation of safety measures, costs associated with accidents can be reduced and result in profit for the organisations in the long run.

2.9. CONCLUSION

The Mining industry is very important especially in South Africa as it has been the cornerstone of its economy for the past few decades and it still is, regardless of its inherent dangers. The apartheid regime in South Africa made the mining industry even more dangerous as the mine owners did not care about the safety of the black mine workers who constituted about 90% of all mine workers.

During this period, the workers were not allowed to complain about safety. The colonial laws which were incorporated in the *Mine and Works Act No. 27 of 1956* and *Occupational Diseases in Mines and Works Act No. 78 of 1973* stated that employees should work first and complain later. Complaint about perceived danger constituted a disciplinary hearing and strikes were considered illegal.

Democracy brought about the new laws which took the right to a safe workplace into consideration. These laws require the owners to provide a safe working environment and to give the employees the right to refuse to perform dangerous tasks. These laws have resulted in a reduction in the number of fatalities and injuries in the mining industry but accidents and fatalities in South African mining industry are still more than those of Australia, Canada and United States of America. It is evident that South Africa still needs to put more effort into ensuring the safety of mine workers and to achieve the 2013 target. South Africa and Canada have a large number mines, the majority of these mines are underground, the number of employees in the mining industry is roughly comparable (500 000 in South Africa and 388 000 in Canada). These countries depend on the mining industry for economic growth, they have a legislative framework that governs the mining industry but the fatality and injury rates in South Africa are three times those of Canada. The best chance that South Africa has of ensuring commitment to safety in the mining industry lies in the government enforcing compliance through fines charged to non-compliant companies and mining operations should be halted after fatal accidents until unsafe conditions have been rectified. The government should also ensure that it sends clear and up-to-date procedures to the mining industry.

Chapter 3 will concentrate on the research design and method that will be applied in the study. The population, sampling procedures and data collection techniques will be discussed. The statistical procedures that will be used empirically to determine the relationship between safety controls and the production cost will also be explained.

CHAPTER 3

RESEARCH METHODOLOGY AND DESIGN

3.1. INTRODUCTION

In the previous chapter focus was on the literature review in relation to safety control mechanisms and production cost within the South African mining industry. The mining industry in South Africa was analysed *inter alia*, through a consideration of the origin of mining within the country, mining during the apartheid era and after democracy, discussion of the legislative framework that governed mining during apartheid and the current legislative framework. Accidents and injuries within the industry were also addressed. The costs associated with these accidents and injuries were also presented as well as the implications that safety controls have on costs. The purpose of this chapter is to provide a description of the research methodology or procedures followed to provide answers to the research question posed in Chapter 1.

According to Pandya (2010:1) research entails investigation in order to ascertain the truth about something, exposing something which was previously unknown, uncertain or in need of testing in order to determine the validity of existing knowledge or a problem undertaken to discover facts and thereby to solve the problem. Research methodology is a framework associated with a certain set of paradigmatic expectations that can be used to conduct research (Quinlan 2011:104). It refers to the steps that are followed to solve a problem. The nature of the problem determines what has to be investigated, area where research has to be carried out, the methods of approaches that have to be applied to in order to derive solutions (Quinlan 2011:142). Therefore, it is the path that needs to be taken in order to move from questions to answers - a research design - has to be established. Research design is a strategy or the plan of action that gives the direction and systemises the research or investigation. It can also be referred to as the plan for conducting a research project. Based on the aforementioned, it can be concluded that research methodology is an outline that gives direction to the research project by providing the system showing how to solve a specific problem by indicating the steps that are necessary to provide answers to research questions, to test the hypothesis and thereby achieve the research purpose (Welman, Kruger & Mitchell 2009:52).

Against this background, the study investigated whether or not the Colliery under study complies with relevant legislation regarding safety controls and to determine whether or not there are safety controls in place to ensure the safety of employees. The study then analysed the production costs at the Colliery in relation to the cost of implementing safety measures. The study further determined whether or not the employees complied with and applied the safety rules and procedures in place to ensure their own safety and the safety of others in the mine. The attitude and the perception of employees at the Colliery towards safety controls were also established. Due to the fact that research is a creative process that requires the use of suitable methods of data collection and analysis in order to accomplish the objectives of the study; this chapter provides details of the research methodology employed and formulated for this research. It focuses *inter alia* on the identification of the target population, sample and sampling procedures, data collection methods, the research instrument, the procedure for the design and administration of the questionnaire. Statistical techniques used in the study, namely, validity and reliability analyses are also explained later in this chapter.

3.2. THE SAMPLE DESIGN PROCEDURE

Sample design procedure refers to the method pursued by the researcher to select a few elements of the entire population that will take part in the study (Berndt & Petzer 2011:165). These elements referred to as the sample, were selected using the following steps:

3.2.1. Target population

Sirakaya-Turk, Uysal, Hammitt and Vaske (2011:96) assert that the target population is the total collection of individuals or units about which the findings of the research are meant to generalise. It indicates the grand total group of what is being studied which has characteristics required by the researcher that will be relevant to the study. This is the group from which the sample is drawn. The target population for this study was restricted to employees and the administrators responsible for keeping the safety records of the selected Colliery in South Africa. It involved all individuals working in the administration and finance department, human resources management, safety department, employee safety representatives, engineering and the top management at the Colliery.

The study also included the foremen, assistant pit-superintendents, supervisors, employees in the mining and plant department as well as engineering and technical services. The total number of employees at the Colliery including top management is one thousand and twenty three (1 023).

3.2.2. Sample

A sample is a segment of the entire target population. As a result, it comprises a small proportion of the total elements. These elements can be items or events or individuals selected for inclusion in the study that are a representative of a larger group as highlighted in 3.2.1 above (Berndt & Petzer 2011:165). The sample should have all the qualities of the entire population from which the sample was drawn in order to allow inferences to be made and to enable generalization of results and should enable a broader applicability of findings of the research (Manoharan 2010:19-20).

3.2.3. Sample size

A sample size denotes the number of sample elements, units or the subgroup of the population chosen or selected to take part in the study to represent the entire population on which inferences will be made. Manoharan (2010:27) concurs that the sample size should be large in order to avoid the error of attempting to bring together a smaller group capable of reflecting the characteristics of the whole population. However, the larger the sample the more it will cost to analyse the data and to administer the survey. Hence, cost and the constraint of time were a major consideration for determining the ultimate sample size. Flin, Mearns, O'Connor and Bryden (2000:180) after reviewing 18 published reports on safety climate, were of the view that the sample size should be greater than 100. Based on the aforementioned, the study used a total of 218 employees which was equal to 20% of the employees including top management. The sample size used was far more than 100 in order to allow for non-response. Again, it is advantageous to have a large sample in order to ensure the accuracy of data analysis. Furthermore; larger samples are more likely to be representative of the population (Daniel 2012:237).

3.2.4. Sampling frame

A sampling frame is the list of all those within the target population that are available for selection. It is the source material regarding target population from where the sample is drawn (Sirakaya-Turk *et al.* 2011:96). The list of all employees was obtained from the database of human resources department at the Colliery in order to determine the number of all employees according to different departments from which the sample was drawn.

3.2.5. Sampling technique

Quinlan (2011:209) emphasizes that sampling technique is the method or procedure adopted and applied by the researcher in selecting the sample from the target population from which inferences were made about the characteristics of the population. Sampling techniques are divided into two categories: probability and non-probability. Probability sampling ensures that all the elements of the population have a known or non-zero opportunity of being selected to take part in the study. The chances of each element being chosen as a participant in the study may not be equal but each one has some chance of being included in the sample. On the other hand with non-probability sampling there is no way of anticipating the chance of any element of the population of being included in the sample. This is because the selection of the sample depends on the personal judgement of the researcher. The method of probability sampling which was applied in this study was the stratified random sampling method. Churchill, Brown and Suter (2010:340) agree that in stratified random sampling, the target population is divided into smaller groups or strata based on the already known characteristics of the population's composition and it is essential for the sample to reflect all these characteristics.

For the purpose of this study, the population was made up of different groups of employees from different departments. This is because based on the departments in which the employees work, the relationship of these employees with risk is different. For example, the employees in the human resources department have a different relationship with risk as compared to the employees in the mining department or engineering department. Based on the aforementioned; these employees cannot be in the same sample batch as the others because the work experiences are not the same and the exposure to hazards is different. Therefore the departments were grouped into Administration, Mining and Plant as well as Engineering and Technical services. The appropriate number was selected from each group from whom information was sought and to ensure that the sample reflects each group in different proportions with the minimum of thirty (30) participants in smaller sub-strata. That is, the larger samples were drawn from larger strata and smaller samples from smaller strata as illustrated in *Table 3.1* using the simple random sampling method. This is referred to as proportionate stratification (Andres 2012:106).

Table 3.1: The number of employees in different departments/strata and proportional sample sizes

Department	Number of employees	Sample size
Engineering and technical services	254	254 * 20% = 51
Mining and plant	686	686 * 20% = 137
Administration	83	83 * 20% = 17 minimum 30
Total	1023	218

3.3. DATA COLLECTION PROCESS

Data collection is the detailed, precise and systematic process on how data will be gathered which is relevant to the specific research problems. Methods which include interviews, participant observations, focus group discussions and case histories can be applied. However, each project or study should attempt to use the most appropriate, relevant and the best way that can be utilized to collect data based on the problem being investigated (Rubin & Babbie 2010:4). To trigger the data collection process for the study at hand; structured questionnaires were distributed to participants in order to generate the quantitative data. The questionnaire provided a set of fixed alternatives from which the respondents chose an answer.

3.4. QUESTIONNAIRE DESIGN

Questionnaires normally consist of a list of questions or statements that respondents are requested to answer or to indicate the extent to which the respondents agree or disagree with the given statements (Rubin & Babbie 2010:94). The purpose of a questionnaire is to gather data in relation to attitudes, beliefs, feelings, behaviour, knowledge of participants as well as demographic characteristics (Pandya 2010:348). Questionnaires can consist of open-ended (unstructured) or closed-ended (structured) questions. A closed-ended or structured questionnaire can include multiple choice questions or scale questions. Closed-ended questionnaires offer the respondents a range of possible pre-determined answers from which the respondent must then select the appropriate answer (Zikmund & Babin 2007:233). The aim of the questionnaire is to ensure that each respondent is presented with exactly the same questions in the same order to ensure reliable aggregation and comparison of answers between survey groups to avoid bias (Pandya 2010:342). In contrast, unstructured questionnaires do not provide predetermined answers but provide a space for the respondents' to write their own answers (Andres 2012:62-63).

For this study; a 5-point Likert scale questionnaire was used ranging from 1 (strongly disagree) to 5 (strongly agree). Clow and James (2014:303) have confidence in that 2-3 point Likert scales lack discrimination ability and therefore make the respondents uncomfortable due to limited freedom of expression. Increasing categories in a Likert- scale increases discriminatory power and improves reliability. However, more points may be too many for some participants and reliability may be affected. Based on the aforementioned; a 5-point Likert scale – the most commonly used scale - was used for the study. It provided a neutral point to ensure that the respondents did not have any difficulty in making choices and to avoid limited freedom of expression (Clow & James 2014:303-305). Likert scales list a number of statements from which respondents are asked to indicate the extent to which the respondents are in agreement or disagreement with each statement (Wiid & Diggines 2009:167). It was used in the study due to its ease of construction and administration (Dhurup 2003:219). Furthermore; it enables the determination of the percentage (%) of negative responses for a given variable. This can be achieved by combining the responses on the scale. For example; agree and strongly agree can be added to establish the strongest performing variable (Dhurup 2003:294). Zikmund and Babin (2013:265) also concur that a Likert scale questionnaire makes it easy for the respondents to read and understand the questions and it is generally used to assess attitude. Hence it was found suitable for the study at hand as it determined the attitude of employees towards safety controls at the mine.

Questions or instruments are used as a vehicle for obtaining the research data. When these questions are designed, it is important to have a significant or extensive knowledge about the subject under study to ensure that relevant and correct questions are asked. The length of the questionnaire depends on the type of respondents. However; a questionnaire should only require at least ten minutes to complete as the questionnaire that takes longer than that may cause the respondents to postpone the completion of the questionnaire. In order to encourage the respondents to fill in the questionnaire and to increase their confidence; classification questions must be placed at the beginning of the questionnaire (Breakwell, Smith & Wright 2012:134). For this study, the respondents were provided with a structured questionnaire to ensure that the time taken to fill the questionnaire was not too long as the questionnaires were filled during shifts. The questionnaire was divided into the following sections:

- Section A comprised questions on the demographic profile of the respondents that is: gender, department, designation, years of experience, academic qualification, home language and English proficiency;
- Section B encompassed questions relating to adherence or compliance of the Colliery with the safety legislation;
- Section C solicited information on the employees' compliance with regard to the application of safety control measures at the Colliery;
- Section D consisted of questions on employees' perceptions and attitude towards safety controls at the Colliery.
- Section E included questions on safety controls and production costs at the Mine. This section ascertained whether the application of safety control mechanisms reduces or increases the production costs within the organisation.

The questions used under Section B, C and D were modified questions adapted from the questionnaire by Laurence in 2005 - four (4) instruments - (2005:41-49) and the questionnaire by Glendon and Litherland - five (5) instruments - (2001:170). This questionnaire was originally developed by Zohar in 1980 named *Safety Climate Questionnaire* (SCQ) (2001:178-181). Eleven (11) questions were obtained from the questionnaire used by Cox and Cheyne to assess safety culture in offshore environments (2000:121). The study also adapted five (5) instruments from the questionnaire by Donald and Canter developed in 1993. This questionnaire is referred to as the

Safety Attitude Questionnaire (SAQ) (Harvey, Erdos, Bolam, Cox, Kennedy & Gregory 2002:26-27). While the remaining seven (7) questions under section B, C and D were obtained from the questionnaire used in the study conducted by Mason, Lawton, Travers, Rycraft, Ackroyd and Collier (1995:47). The rest of the questions under Section A and E were developed by the researcher.

3.4.1. Administration of the questionnaire

In order to make sure that the questionnaire reached the respondents and to enable gathering of data; the questionnaires were printed on paper and handed to the respondents. The questionnaires were self-completed by the respondents but the researcher was available at the time the questionnaires were completed. The researcher was available when the questionnaire was filled in (except for the mining and plant departments), just in case problems were experienced, to give instructions that the respondents had to follow when filing in the questionnaire, to clarify the questions, encourage the respondents to continue to fill in the questionnaire and to lead the respondents back to the subject and to ensure that all questionnaires were collected from the participants (Rubin & Babbie 2010:100). Access to the mine and plant departments was prohibited due to production problems which were encountered at the Colliery during the data collection period.

To ensure that the employees understood the reasons why the questionnaire had to be filled in, why information was sought from them and the purpose of the research, the covering letter was attached to the questionnaire (Clow & James 2014:243).

3.4.2. Covering letter

The covering letter is an important means of requesting a reader to complete and return the questionnaire. The purpose of the covering letter was to ensure that the respondents understand the purpose of the study and to provide assurance that all the information obtained would be treated with great confidentiality, the results would be used for research purposes only and that the respondents would remain anonymous (Zikmund, Babin, Carr &Griffin 2013:220). The covering letter included the instructions on how the questionnaire was to be completed, what was expected from the respondents when completing the questionnaire and the letter thanked the respondents for the time spent filling in the questionnaire and their assistance with regard to the study. The details and the contact information of the researcher were also provided as well as the university involved (Churchill, Brown *et al.* 2010:309).

To guarantee that the questionnaire communicated information correctly and clearly to the respondents, a pre-test of the questionnaire was undertaken.

3.5. PRE-TESTING OF THE QUESTIONNAIRE

Pre-testing refers to the screening of the questionnaire in order to ensure that there are no problems regarding the instructions given to the respondents or the design of the questionnaire (Zikmund *et al.* 2013:231). Before the distribution of the final questionnaire; it was pre-tested using the following steps. First, the questionnaire was presented to the financial manager, human resources manager of the Colliery, one of the assistant pit superintendents, the safety officer and employee safety representative to establish if any additional points needed to be included in the questionnaire. Furthermore; the pre-test was conducted to ensure that the questionnaire was not too long, to determine the interest of the participants and their attention when filling in the questionnaire. Secondly, five randomly selected employees were given the questionnaire to answer the questions and to indicate whether or not the respondents understood the questionnaire's instructions, the meaning of the questions, the terminology used and to determine the simplicity of the questionnaire (Berndt & Petzer 2011:146-147).

In order to obtain relevant feedback from the respondents; they were informed before the completion of the questionnaire that they were part of a pre-test and should therefore write their comments and recommendations regarding the simplicity and comprehensibility of the questions, relevance, and the time taken to fill the questionnaire. All the ten questionnaires were collected and suggestions were incorporated into the questionnaire. Hence, after careful modifications; the questionnaire was distributed to randomly selected respondents for a pilot study.

3.6. PILOT TESTING OF THE QUESTIONNAIRE

The purpose of pilot study is to determine whether the techniques used to collect information are actually doing what they are supposed to be doing (Breakwell *et al.* 2012:10). A Pilot study was carried out using a number of respondents limited to fifty who were selected from the same population as the final target group in order to determine whether or not the methods and procedures applied in the study would work. It was also used to determine the limitations and errors before the questionnaires was distributed to the participants. It also provided the opportunity to ensure that the questionnaire covered all the information that it was intended to cover, to determine the reliability and validity of the questionnaire before it was applied on a larger scale (Andres 2012:27). Simple random sampling was applied in this regard. The employees used for pre-test and pilot study were excluded from the sample used for the main study.

3.7. RELIABILITY

Reliability indicates the overall consistency of the measuring instrument. It is reliable if it produces similar results under the same conditions (Welman *et al.* 2009:9). This also implies that over a period of time the measure must be stable in order to produce the same results constantly. It therefore refers to the stability and consistency of the measuring instrument to provide the same information if used by different people, under the same conditions but at different times (Goddard & Melville 2009:41). Therefore, individual questions were measured to determine consistency using Cronbach's alpha coefficient (Goddard & Melville 2009:46). Coefficient Alpha ranges from 0 to 1. The value of 0.60 or less designates inadequate reliability while 0.70 and above indicates a good reliability. The results with regard to the reliability of the questionnaire were substantiated in Chapter 4.

3.8. VALIDITY

Validity is used to establish whether the measuring instrument measures what it is intended to measure and that it is measured appropriately (Welman *et al.* 2009:9). There is a claim that there is a relationship between reliability and validity because if a measure is valid also considered to be reliable. As a result, it could be maintained that a measure is valid if it is also reliable (Goddard

& Melville 2009:41). The types of validity examined were content validity and construct validity. Content and construct validity were explained in detail in Chapter 1.

3.9. DATA COLLECTION METHOD

There are two research designs or methodological paradigms of data collection methods used in research. Pandya (2010:53) maintains that research design is the structure, plan or system that is intended to be followed to find answers or facts about a particular study. It includes the planning of the research procedure as well as the procedure for data collection and analysis. It is therefore the logical sequence that connects the data to the research questions and the conclusion of the study (Berndt & Petzer 2011:44). These two research designs are briefly explained as thus:

Qualitative research design: Pandya (2010:42-43) describes the qualitative research design as aiming at determining the dynamic and changeable nature of reality by collecting subjective data, presented verbally by people. This refers specifically to the design that generates non-numerical data which are recorded in the form of language (Wegner 2012:10). It involves conducting studies in natural settings using verbal descriptions resulting in case studies and stories rather than statistical reports as would be the case with quantitative research method.

Quantitative research design: As pointed out by Pandya (2010:40), the aim of this method is to be particularistic in approaching the collection of data. This signifies evaluating objective data which consist of numbers in order to summarize, describe, and to identify relationships and differences in groups. Quantitative research design quantifies data and statistical techniques are used to draw inferences (Wegner 2012:10). In this study this technique will be used mainly to examine employees' perceptions with regard to: (1) organizational adherence or compliance to safety legislation, (2) employees' compliance with the application of safety control mechanisms, (3) employees' attitude towards safety control, and (4) production cost's relation to safety control mechanisms. Moreover, the quantitative research approach was used in the study to eliminate the possible subjectivity of judgement.

3.10. DATA ANALYSIS

Data analysis refers to the organisation of data and breaking it down into patterns, discovering what is important that is learned from the data and deciding what to tell to others that has been revealed in the investigation. All data was entered into a Microsoft Excel spread sheet and then transported to the Statistical Package for Social Sciences (SPSS) version 21.0 for Windows. SPSS is the statistical package which is used to code data and to run statistical analysis (Andres 2012:150). The data was analysed using the methods listed below and the statistical results were validated and reported in Chapter 4.

3.10.1. Descriptive statistics

Descriptive statistics are used to classify, summarise and extract essential and important information contained in the data in relation to the study. They enable the user to identify profiles, patterns within the responses of participants, relationships and trends and therefore present quantitative descriptions in a manageable form (Manoharan 2010:663-665). These statistics are used to explain data obtained from participants using measures of central tendency (mean, median, and mode), measures of dispersion (range and standard deviation) to establish how central the data are around the mean – the more concentrated, the smaller the standard deviation, measures of shape (skewness and kurtosis) to determine the distribution of data around the mean and measures of association (Coussement, Demoulin & Charry 2011:47). See *Table 4.6*.

3.10.1.1. Measures of central tendency

Measures of central tendency attempt to describe the data by determining the value that represents the middle or the centre of its distribution. The three measures of central tendency are arithmetic mean, median and mode. Mean indicates the sum of the value of each observation in a dataset divided by the number of observations. Mode is the most commonly occurring value in a distribution while median is the value that lays at the centre of the distribution when values are arranged in chronological order by either beginning with the highest or the smallest (Manoharan 2010:74-79). The study determined the mode which was the most occurring number to establish the (1) compliance of the Colliery in question with safety regulations (section B), to determine the (2) compliance of employees in relation the application of safety measures (section C), to examine the (3) attitude and perceptions of employees towards safety controls (section D) as well as the (4) safety control mechanisms and their relation to production cost at the Colliery (section E).

3.10.1.2. Categorical frequency tables

Categorical frequency tables are the tools used to classify various responses into categories then to count the number of responses in a particular category to enable the reporting of overall results. The tables show the number of appearances for each category in the sample and determines the importance of the different categories. That is; the data is explained by indicating the number of times a certain value of a variable appears. The counts in the study were expressed as percentages as they are easy to understand and interpret, to enable easy comparison between strata and to produce percentage frequency tables. The findings for section A, B, C, D and E were shown graphically using bar charts and pie charts (Churchill *et al*. 2010:42).

3.10.2. Exploratory Factor Analysis

Exploratory factor analysis is a statistical technique that is used to reduce a larger number of items by grouping them into smaller subsets of factors. It establishes underlying or latent constructs or dimensions by sieving out bits of information that we do not need to know about (Bryman & Cramer 2011:318). Furthermore, it is a tool that is used to determine construct validity of the instrument (Williams 2012:2). This technique was utilized in this study to explore possible underlying constructs not to verify the factor structure or to fit a certain model. This is referred to as the Confirmatory Factor Analysis. In order to discriminate between factors and to simplify the interpretability of relationships between factors; factor rotation was performed (Field, Miles & Field 2013:765). Rotation is a technique used to establish and explain the relationship between factors and variables by maximizing the loading of each variable on one of the extracted factors while minimizing the loading on all other factors (Field 2009:643-644). The Varimax rotation method with Kaiser Normalisation was used in the study to improve or simplify the interpretation of factors. The factor analysis was used for sections B, C, D and E; hence the results reported in Chapter 4.

3.10.3. Analysis of variance (ANOVA) and t-test

Analysis of variance is a statistical tool that is utilised to establish the differences among the group means. If there are any differences found, ANOVA and t-test indicate exactly where the differences are found and the degree to which two (t-test) or more (ANOVA) group means vary or differ (Clow & James 2014:413-414). As a result ANOVA makes it possible to conclude whether the factor has an influence on the outcome of the response or the two are perhaps independent of each other. That is; there is no statistical relationship between them (Wegner 2012:278-284). For this study One-way Analysis of Variance was applied to compare the means of different strata to determine if there are any significant differences between the responses of administration staff (including top management), engineering and technical services and the employees in the mine and plant. The differences were established based on the participants' responses in relation to their perceptions regarding the organisation's adherence to safety legislation, employees' attitude towards the safety control measures, employees' compliance concerning the application of safety controls as well as the perceptions of the effectiveness of these safety measures and the impact on production cost within the mine. The results of one-way ANOVA are confirmed and highlighted in Chapter 4.

3.11. ETHICAL CONSIDERATIONS

Ethics are moral principles and rules of conduct dealing with what is right and what is wrong. Ethical constraints are put in place in order to protect all those who may be involved in the data collection so that no individual or group is harmed in any way. Hence, there are several ethical codes that guide the researchers and provide guidelines and principles for conducting of research with human participants (Berndt & Petzer 2011:294).

Ethical issues which were followed in this study were as follows:

- Written permission was obtained from the management of the Colliery under study to conduct research in their organization.
- Respondents voluntarily chose to participate in the study by filling in and signing the consent form;
- Personal data of respondents was processed fairly and lawfully and used only for the purpose of the study;
- Personal responses from individuals were not attributed to any individual. All data was computed in collectively and not linked to any respondent;
- The respondents were requested not to write their names on the questionnaire to ensure and to maintain the anonymity of respondents throughout the study;
- Professional ability in the data collection and analysis was preserved;
- Independent impartiality in the interpretation of the survey findings was upheld;
- The purpose of the study was communicated to the participants to enable them to make an informed decision regarding participation in the study; and
- The information voluntarily disclosed by participants was not disclosed to anyone (Berndt & Petzer 2011:294-295).

3.12. CONCLUSION

In this chapter the research objectives and target population were described. The chapter also described and justified the methodology used in the research design, measuring instrument, construction of the questionnaire, sampling process and data collection method. The techniques applied to ensure validity and reliability of the questionnaire were also discussed in this Chapter. The discussion included construct, content, confirmatory and convergent validity. Lastly, the data analysis and the statistical procedures followed and the reasons why they were applied in the study were explained. The results of the data collected through the questionnaire are presented and interpreted in Chapter 4.

CHAPTER 4

ANALYSIS AND INTERPRETATION OF EMPIRICAL FINDINGS

4.1. INTRODUCTION

The main focus of the preceding chapter was on the detailed explanation of the method used in conducting the research involving data collection techniques as well as the methods used to make sense of the data collected. This chapter therefore concentrates on the actual analysis of data obtained through the pilot study and the main survey.

The data was obtained through the distribution of questionnaires and captured using Microsoft Excel for Windows. The Excel document was then transported to the Statistical Programme for the Social Sciences (SPSS) version 21.0 for the processing and analysis of data. The frequency tables were used in the study to classify the responses of the participants; the descriptive statistics analysed the mean, spread and shape; exploratory factor analysis was utilized to determine the latent variables under each of the four sections (B, C, D and E) while ANOVA and t-test were applied to determine the difference between group means

To present the results; figures and frequency tables were used in the chapter to profile the participants according to gender, departments, designation, years of experience, home language and English proficiency. These tables were further utilised to summarise the results of the participants' disagreement and agreement with the statements provided in relation to safety issues within the organisation. All these results are presented and discussed in this chapter.

4.2. PILOT TESTING OF THE QUESTIONNAIRE

Fifty questionnaires were distributed for pilot study and forty-seven questionnaires were collected from the respondents. The purpose of the pilot study was to determine whether or not the statistical analysis techniques and procedures utilised were appropriate for the study, to ensure that there were no mistakes in the questionnaire, to make certain that it is easy to understand and therefore it should not take too long to complete before the final distribution. It also provided the opportunity to ensure that the questionnaire covered all the information that it was intended to cover, to determine the reliability and validity of the questionnaire before it was applied on a larger scale.

4.3. RELIABILITY AND VALIDITY

In establishing the reliability of the questionnaire, Cronbach's alpha was computed. The results for internal consistency of the scale are reported in *Table 4.1* with Cronbach's alpha values reflecting acceptable levels. Cronbach's alpha ranges from 0 to 1. The higher or closer the value is to 1, the more reliable the instrument is. The score of 0.60 and below is considered poor, between 0.60 and 0.70 is fair while the score of the instrument between 0.70 and 0.80 is considered to have a good reliability. Based on the above-mentioned and the values in the table below, it can be concluded that the instrument used was reliable as the scale achieved the scores ranging between 0.77 (77 %) and 0.87 (87%). The values were satisfactory due to the fact that they were above the benchmark level of 0.70 (Zikmund & Babin 2007:322). Content and construct validity were established through the use of experts in the fields of Accounting and Safety. The questionnaire was reviewed by the Supervisor, Co-supervisor, Statistician, Academics and the Financial Manager at the Colliery. Some items were removed, rephrased and new items were added to the questionnaire to ensure that it covered all the aspects and constructs. All the mistakes identified were corrected and all suggestions were incorporated in the questionnaire before it was distributed for the main survey.

Table 4.1: Reliability of the questionnaire

Constructs	**Cronbach's alpha**	**Cronbach' alpha based on standardized items**	**No. of items**
Compliance or adherence to safety legislation (Section B)	0.87	0.89	12
Employees' compliance regarding the application of safety control measures (Section C)	0.80	0.80	10
Employees' perception and attitude towards safety controls (Section D)	0.77	0.77	10
Safety control measures and production cost (Section E)	0.86	0.85	24

4.4. RESULTS OF THE MAIN SURVEY

The questionnaire consisted of five sections. Section A covered the general information of the respondents. Section B to E comprised variables which requested the respondents to indicate the extent to which they agreed with the statements given in these sections using a 5-point Likert scale where 5 indicated strongly agree and 1 indicated strongly disagree. Under Section B the participants were requested to determine the adherence or compliance of the Colliery with regard to safety legislation. Section C established the compliance of the respondents in relation to the application of safety rules. Section D comprised variables which assessed the attitude and perceptions of the respondents in relation to safety controls while Section E analysed the perceptions of employees with regard to costs and safety control measures at the Colliery.

The population in this study was divided into strata from where the respondents were randomly selected. The sample of 218 participants was used and therefore 218 questionnaires were distributed for the main survey. 151 (69.3%) were correctly filled in and usable questionnaires were received from the respondents. The findings from the main survey are reported and discussed below.

The remaining part of Chapter 4 is an analysis of the results based on 151 completed and usable questionnaires. The analyses are reported in the same sequence as the questions in the questionnaire that can be viewed in the *Annexure 1*. Specific questions will be referred to in accordance with their sections and the number of the question will be recorded under each section in the questionnaire. This indicates, for example, that the question numbered BQ1, refers to question 1 under section B.

4.4.1. Frequency distributions

4.4.1.1. Section A: General information

This Section requested the respondents to provide their personal information which included gender, department, designation, years of experience, academic qualifications, home language and English proficiency level.

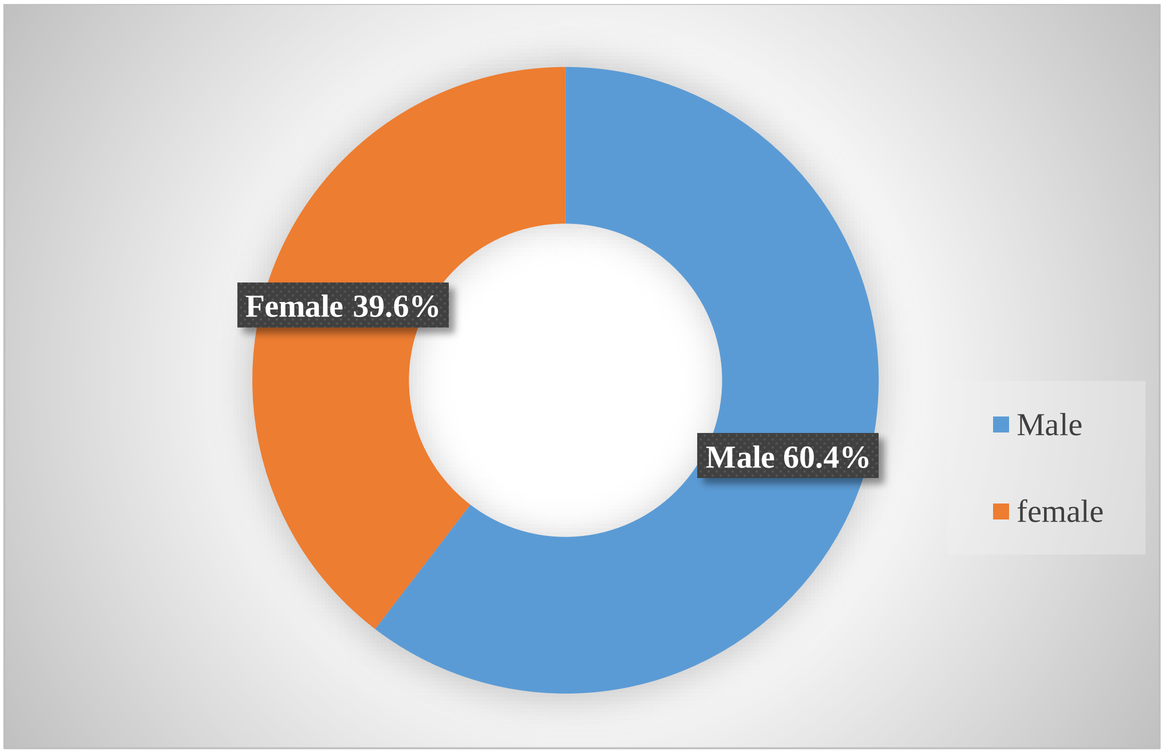


Figure 4.1: Gender

Figure 4.1. indicates the composition of the sample. The sample of 218 from the total of 1023 employees at the Colliery was used. Out of 218 distributed questionnaires; only 151 questionnaires were returned and used for the study as mentioned earlier. Only 149 indicated their gender, 59 (39.6%) were female and 90 (60.4%) were male .

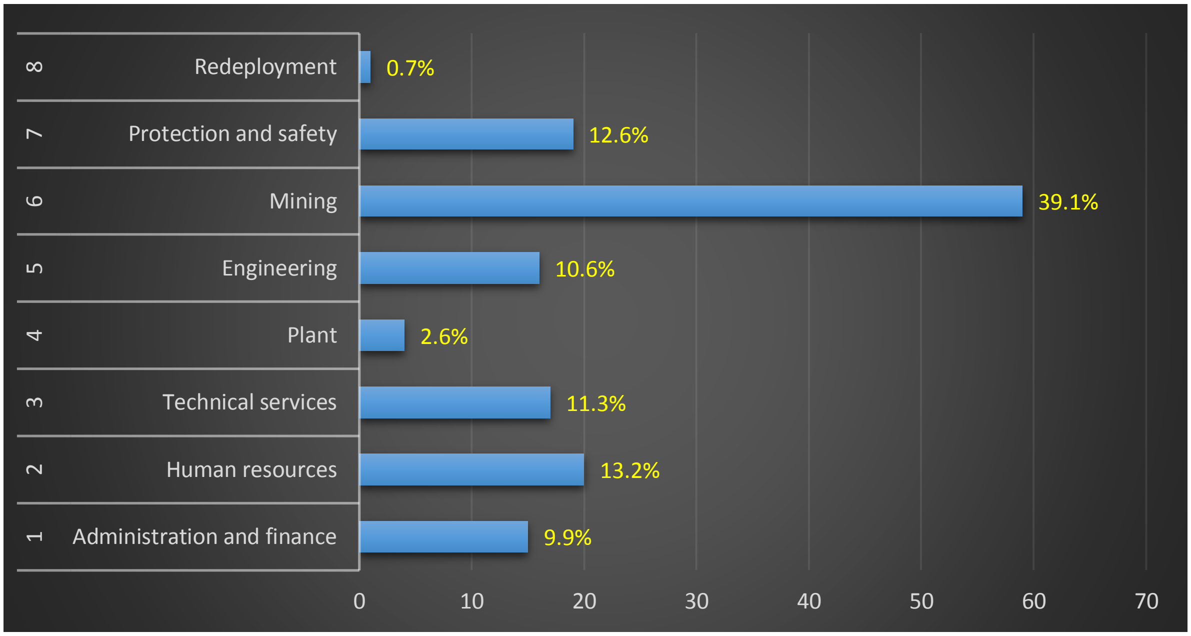


Figure 4.2: Department

Figure 4.2 provides information regarding the composition of the sample in accordance with different departments. The majority of participants were from the mining department which is the hazardous area of the Colliery and the respondents in this department formed 39.1% (59) of the sample (151).

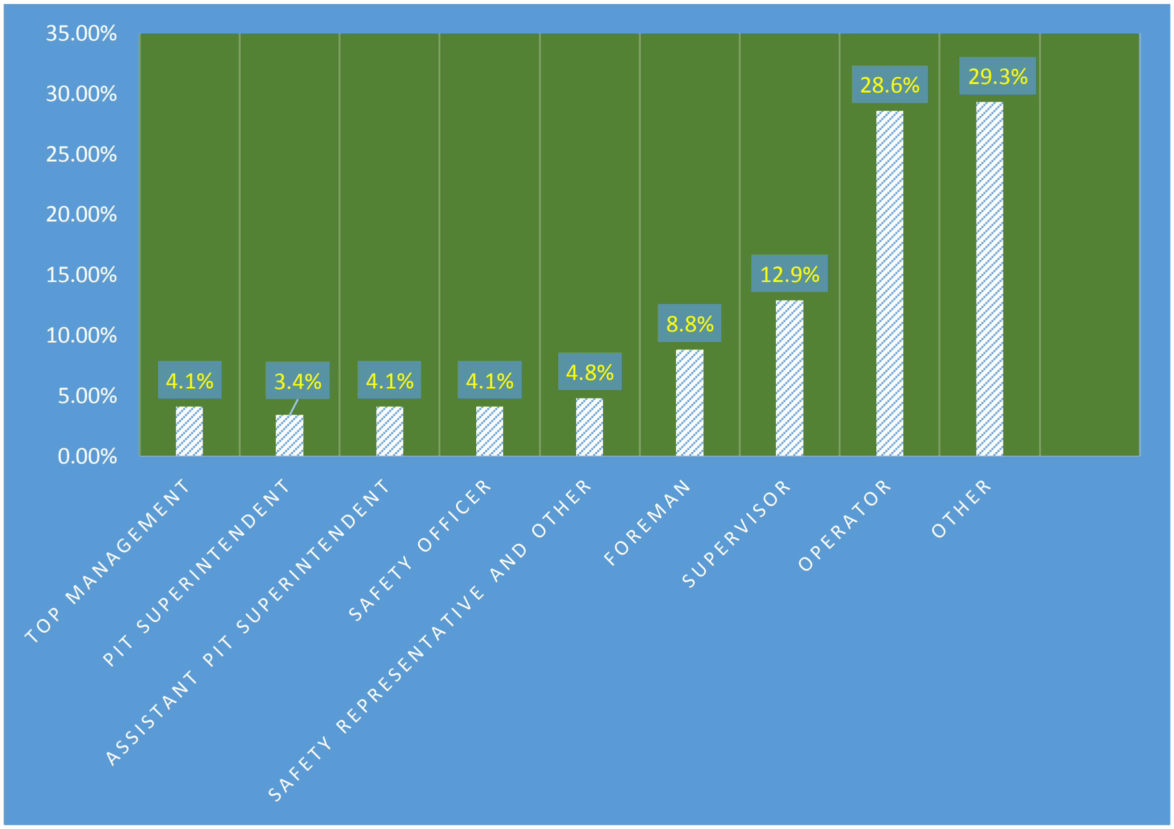


Figure 4.3: Designation

The composition of the sample according to their designation is reported in *Figure 4.3*. Of the 151 respondents, 147 indicated their designation therefore 6 (4.1%) formed part of top management, 5 (3.4%) pit superintendents, 6 (4.1%) assistant pit superintendents, 6 (4.1%) safety officers, 7 (4.8%) safety representatives and other. (Note that safety representatives can also occupy other positions for example; one can be a safety representative and also an operator). A total of 13 (8.8%) respondents were foremen, 19 (12.9%) supervisors, 42 (28.6%) operators. Therefore; there is 42.2% (4.1% + 3.4% + 4.1% + 4.1% + 4.8% + 8.8% + 12.9%, the first seven pillars) of the respondents who can be looked to in order to guarantee the safety (to the greatest extent that it can be guaranteed) of the mine through resource allocation, identification of risks, provide assurance that safety measures are in place to control risks and enforce the application as well as ensuring the implementation of safety measures. The largest group in this collective is noted as ‘Other’ with 44 (29.3%) of 151 participants. This majority grouping comprise clinic staff, administration and finance, human resources management, protection and safety as well as redeployment.

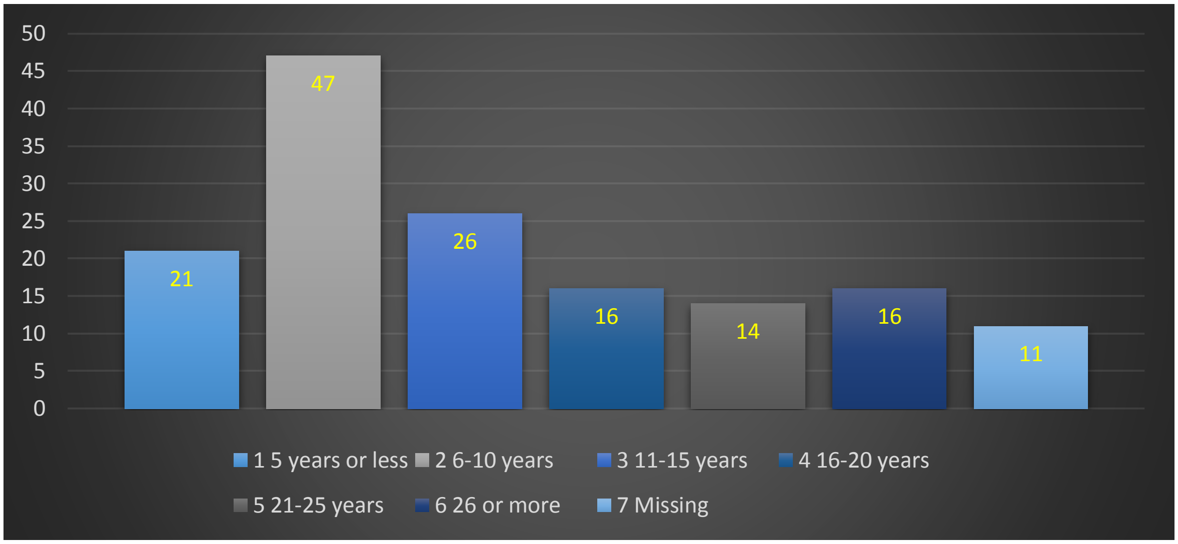


Figure 4.4: Years of experience

The figure above (*Figure 4.4*) shows the respondents' years of experience. The majority (47/31.1%) of participants have 6 to l0 years of experience unfortunately (11/7.3%) did not indicate their work experience.

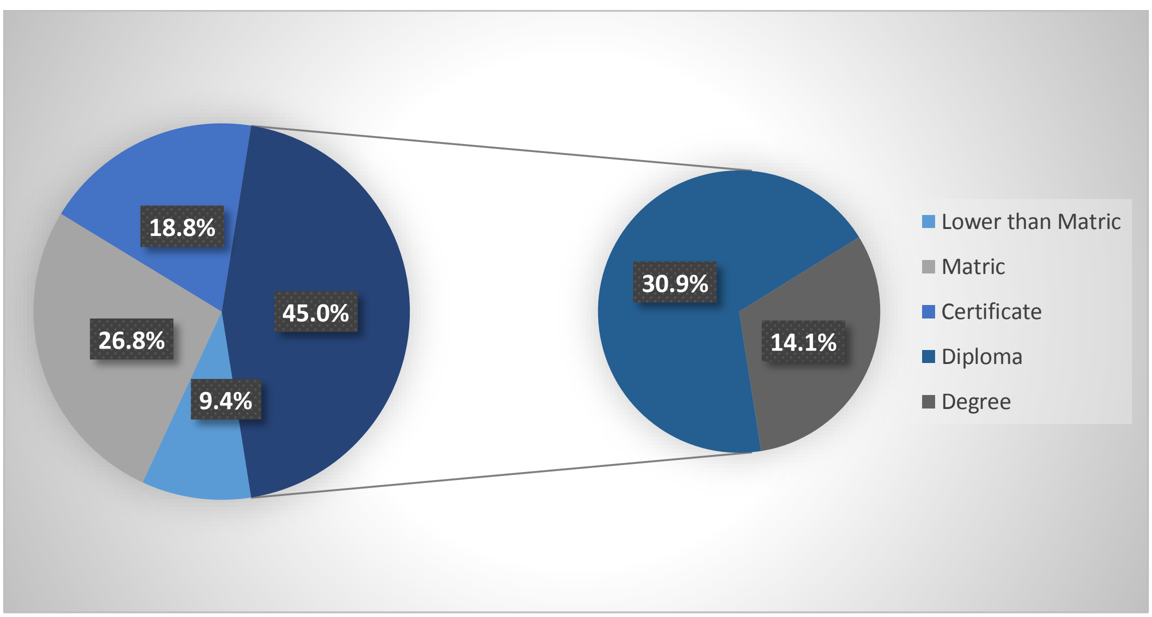


Figure 4.5: Qualification

Figure 4.5 exhibits the participants' level of education. 149 participants specified their qualification. Participants with a Certificate make up 18.8% (28) of the sample while the Diploma and Degree holders collectively represent almost half of the participants as indicated in the bigger pie chart - 67 (45.0%). The smaller pie chart on the right shows the number of the participants with Diplomas (46/30.9%) and Degree qualifications (21/14.1%) separately. Accordingly; more than half - 95 (63.8%) - of the participants have some form of tertiary qualification with the highest number being Diploma holders followed by those who have completed Matric 40 (26.8%). A small portion of the sample 14 (9.4%) have not completed Matric.

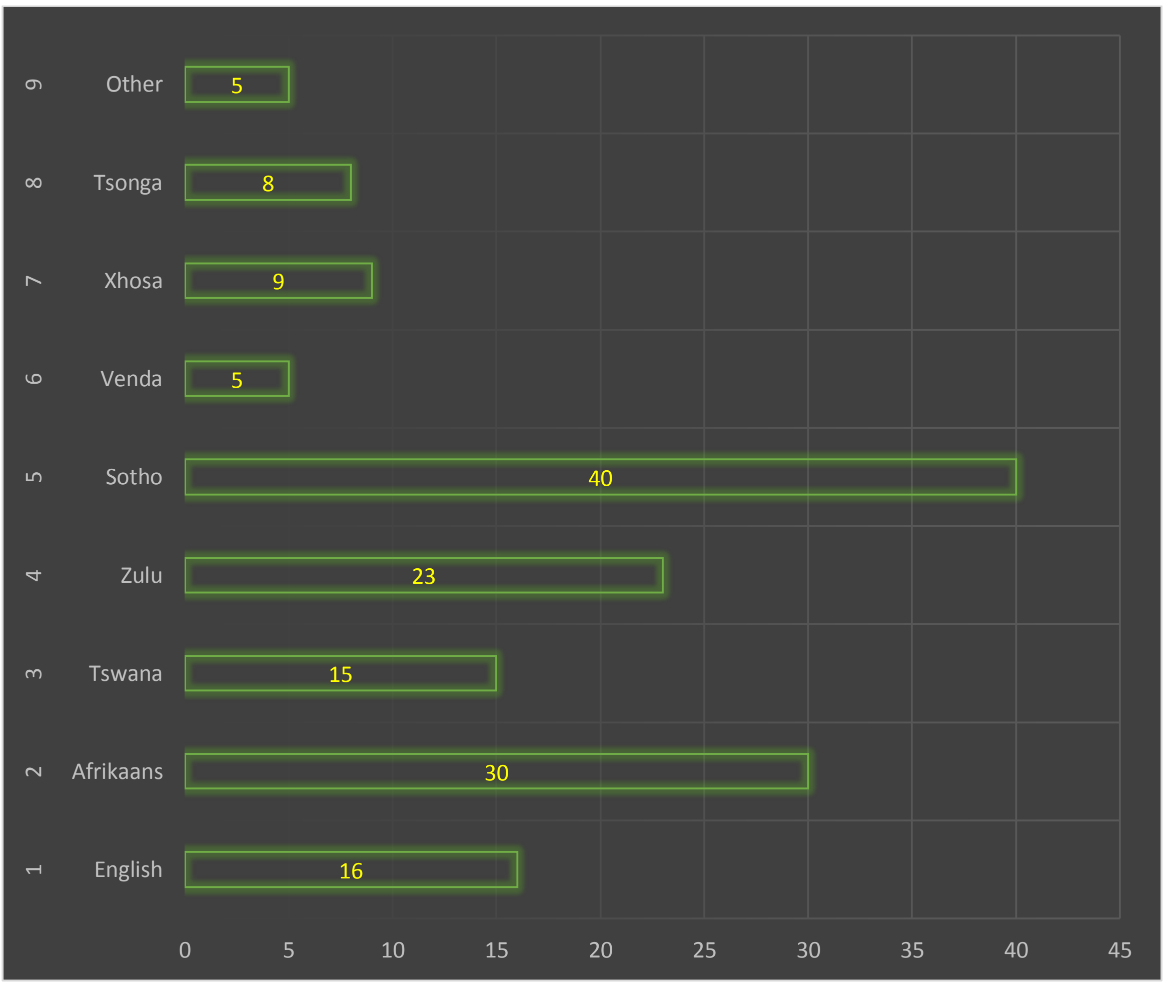


Figure 4.6: Home language

The breakdown of different languages of the population is provided in *Figure 4.6* with the majority of the respondents speaking Sotho - 40 (26.5%) followed by Afrikaans 30 (19.9%) and Zulu with 23 (15.2%). The lowest number of respondents were Venda speaking 5 (3.3%).

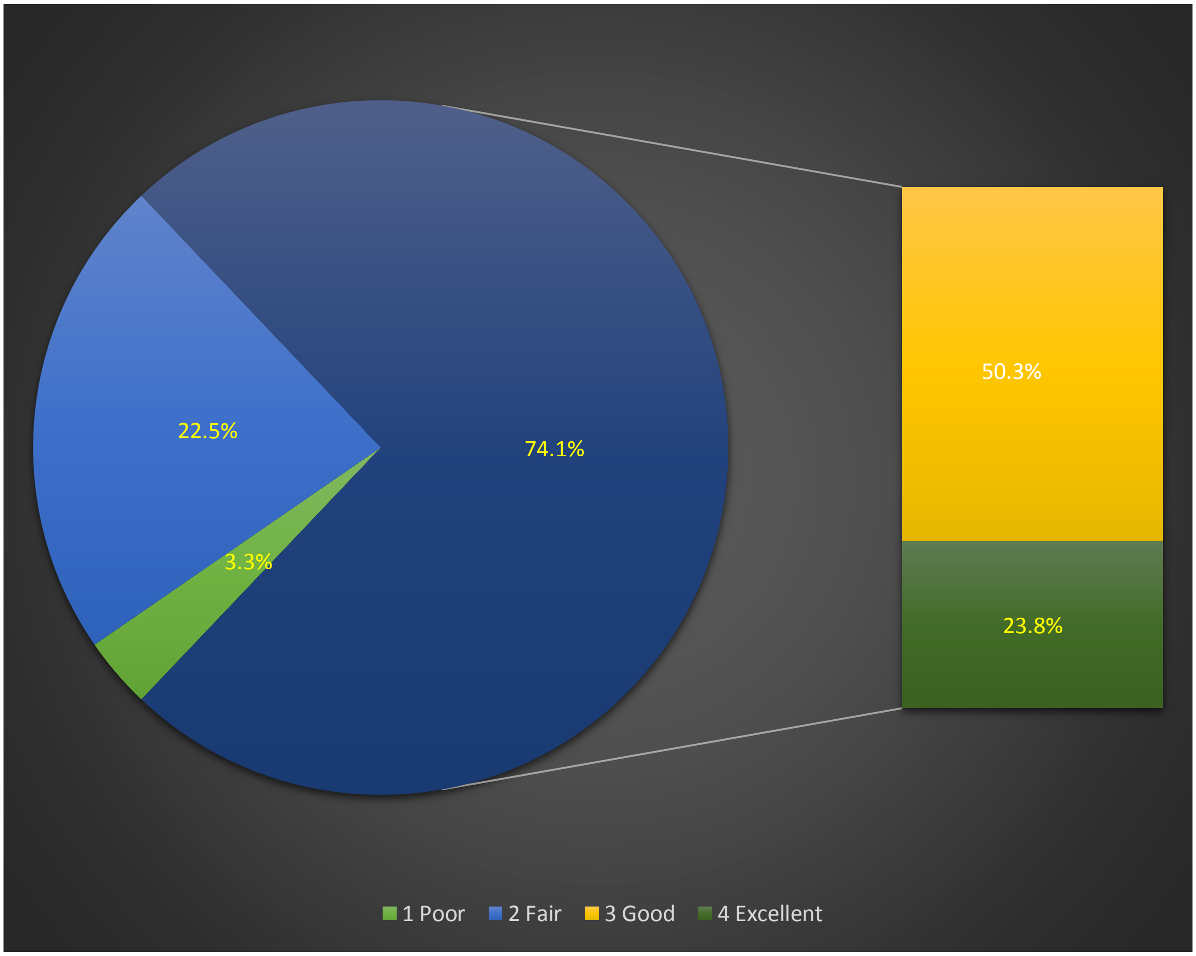


Figure 4.7: English proficiency

As highlighted and revealed in *Figure 4.5*; a high number of respondents have some form of qualification. The qualifications of the participants range from Matric to Degrees with a high number of diploma holders. Hence the results shown in *Figure 4.7* indicating the participants who can read, write and speak English very well – 112 (74.1%). This number is made up of participants who rated their English proficiency between good 76 (50.3%) and excellent 36 (23.8%).

4.4.1.2. Section B: Adherence of the Colliery to safety legislation

Table 4.2: Responses of participants based on their agreement or disagreement with the statements.

Item description	***Strongly Disagree***		***Disagree***		***Moderately Agree***		***Agree***		***Strongly Agree***		***Total***	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
1. The organisation is up to date with safety legislation.	0	**0**	4	**2.6**	15	**9.9**	83	**55.0**	49	**32.5**	151	**100**
2. There is safety policy regarding the safety of employees.	1	**0.7**	2	**1.3**	22	**14.6**	57	**37.7**	69	**45.7**	151	**100**
3. There are safety measures to ensure the safety of employees.	0	**0**	2	**1.3**	12	**7.9**	65	**43.0**	72	**47.7**	151	**100**
4. Employees are made aware of possible hazards associated with their jobs.	2	**1.3**	1	**0.7**	15	**9.9**	69	**45.7**	64	**42.4**	151	**100**
5. There are safety procedures to guide the performance of tasks.	0	**0**	3	**2.0**	16	**10.6**	61	**40.4**	71	**47.0**	151	**100**
6. There are regular safety control meetings.	0	**0**	4	**2.6**	16	**10.6**	66	**43.7**	65	**4.3**	151	**100**
7. Effective documentation ensures the availability of safety procedures.	0	**0**	4	**2.6**	17	**11.3**	73	**48.3**	57	**37.7**	151	**100**
8. Safety representatives are involved in putting together the safety procedures.	4	**2.6**	4	**2.6**	21	**13.9**	74	**49.9**	48	**31.8**	151	**100**
9. Personal protective equipment (PPE) is provided freely at all times.	0	**0**	2	**1.3**	17	**11.3**	60	**39.7**	72	**47.7**	151	**100**
10. Management learns from past mistakes.	0	**0**	4	**2.6**	22	**14.6**	66	**43.7**	59	**39.1**	151	**100**
11. Management considers safety to be equally as important as production.	5	**3.3**	8	**5.3**	22	**14.6**	60	**39.7**	56	**37.1**	151	**100**
12. Supervisors seldom discipline employees who break the safety rules.	10	**6.6**	23	**15.2**	24	**15.9**	59	**39.1**	35	**23.2**	151	**100**

According to the results shown in *Table 4.2*; **97.4%** (9.9% + 55.0% + 32.5%) of 151 respondents are of the opinion that the organisation is up to date with safety legislation (BQ1) while **98%** (14.6% + 37.7% + 45.7) indicated the availability of safety policy (BQ2). **98%** (9.9% + 45.7% + 42.4%) are in agreement that the employees are made aware of possible hazards associated with their jobs (BQ3), **98.6%** (7.9% + 43.0% + 47.7%) specified that there are safety measures to ensure the safety of employees (BQ4), **98.6%** (7.9% + 43.0% +47.7%) highlighted that there are safety measures in place to ensure safety and to guide the performance of tasks (BQ5). Only **58.6%** (10.6% + 43.7% + 4.3%) stated that there are regular safety control meetings (BQ6). **97.3%** (11.3% + 48.3% + 37.7%) identified that effective documentation ensures the availability of safety procedures (BQ7). **95.6%** (13.9% + 49.9% + 31.8%) confirmed that safety representatives at the Colliery are involved in putting together the safety procedures (BQ8). Participants are also of the view that personal protective equipment (PPE) is provided freely at all times at the Colliery – BQ9 - (**98.7%** = 11.3% + 39.7% + 47.7%) and **97.4%** (14.6% + 39.7% +37.1%) acknowledged that management learns from past mistakes (BQ10) and consider safety to be equally as important as production. This was admitted by **91.4%** (14.6% + 39.7% +37.1%) of the respondents (BQ11). However; **78.2%** (15.9% + 39.1% + 23.2%) are of the opinion that supervisors seldom discipline employees who break the safety rules (BQ12).

The outcomes above which are based on the perceptions of the employees point out the compliance of their organisation with safety legislation. It can therefore be concluded that the organisation is compliant and conforms to the relevant legislation regarding safety. Therefore; empirical objective one (see chapter 1) has been achieved.

4.4.1.3. Section C: Employees' compliance regarding the application of safety control measures

Table 4.3: *Responses of participants based on their agreement or disagreement with the statements given below*

Item description	***Strongly Disagree***		***Disagree***		***Moderately Agree***		***Agree***		***Strongly Agree***		***Total***	
	N	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
1. I often deviate from safety rules.	42	**27.8**	56	**37.1**	29	**19.2**	16	**10.6**	8	**5.3**	151	**100**
2. I have found better ways of doing my job.	19	**12.3**	30	**19.9**	25	**16.6**	60	**39.7**	17	**11.3**	151	**100**
3 Some rules are impossible to apply.	29	**19.2**	52	**34.4**	36	**23.8**	23	**15.2**	11	**7.3**	151	**100**
4. There are too many safety rules that one cannot remember.	25	**16.6**	48	**31.8**	35	**23.2**	33	**21.9**	10	**6.6**	151	**100**
5. Safety rules are written in the language that I understand well.	17	**11.3**	15	**9.9**	32	**21.2**	54	**35.8**	33	**21.9**	151	**100**
6. Employees often give tips on how to work safely	4	**2.6**	19	**12.6**	29	**19.2**	60	**39.7**	39	**25.8**	151	**100**
7. I have difficulty getting hold of written safety rules.	34	**22.5**	58	**38.4**	30	**19.9**	20	**13.2**	9	**6.0**	151	**100**
8. Safety rules are only for inexperienced workers.	72	**47.7**	43	**28.5**	15	**9.9**	15	**9.9**	6	**4.0**	151	**100**
9. I can get the job done by ignoring the safety rules.	67	**44.4**	42	**27.8**	17	**11.3**	19	**12.6**	6	**4.0**	151	**100**
10. Sometimes I do not understand which rules to apply.	40	**26.5**	48	**31.8**	36	**23.8**	23	**15.2**	4	**2.6**	151	**100**

Table 4.3 indicates that out of **151** respondents who completed the questionnaire correctly; only **35.1%** (19.2% + 10.6% + 5.3%) indicated that they often deviate from safety rules (CQ1), **67.6%** (16.6% + 39.7% +11.3%) have found better ways of doing their job (CQ2) and **53.6%** (19.2% +34.4%) do not consider some rules to be impossible to apply (CQ3). **51.7%** (23.2% + 21.9% + 6.6%) are in agreement and of the opinion that there are too many safety rules that one cannot remember (CQ4). However; the safety rules are written in the language that participants understand well - (**78.9%** = 21.2% + 35.8% + 21.9%) - hence the results in *Figure 4.7* (CQ5). **83.7%** (19.2% + 39.7% + 25.8%) respondents came to an agreement that employees often give tips on how to work safely which indicates a very supportive work environment (CQ6). **60.9%** (22.5% + 38.4) disagree that it is difficult to get hold of written safety rules (CQ7). This is supported and confirmed by the results in BQ7. **76.2%** (47.7% + 28.5%) recognize that safety rules are not only for inexperienced workers (CQ8) and **72.2%** (44.4% + 27.8%) do not agree that the safety rules should be ignored to get the job done (CQ9). **58.3%** (26.5% + 31.8%) emphasized that they always understand which rules to apply (CQ10).

According to these results, the majority of the respondents indicated their compliance with safety rules and also pointed out that they do apply the safety rules. It can therefore be concluded that the employees at the Colliery abide by the safety rules and realise the need to apply the safety rules and procedures. As a result, the second empirical objective has been realised.

4.4.1.4. Section D: Employees' perceptions and attitude towards safety control measures

Table 4.4: Responses of participants based on their agreement or disagreement with the statements given below

Item description	***Strongly Disagree***		***Disagree***		***Moderately Agree***		***Agree***		***Strongly Agree***		***Total***	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
1. Safety rules are used to protect management's back	52	**34.4**	48	**31.8**	32	**21.2**	13	**8.6**	6	**4**	151	**100**
2. Acting with common sense is safer than acting within safety rules.	44	**29.1**	59	**39.1**	27	**17.9**	16	**10.6**	5	**3.3**	151	**100**
3. It is necessary to break the rules to get the job done.	57	**37.7**	54	**35.8**	20	**13.2**	13	**8.6**	7	**4.6**	151	**100**
4. Safety rules make easy tasks complicated.	42	**27.8**	51	**33.8**	19	**12.6**	28	**18.5**	11	**7.3**	151	**100**

5. Safety is not my role.	82	**54.3**	35	**23.2**	12	**7.9**	20	**13.2**	2	**1.3**	151	**100**
6. Working safety rules remove skills.	50	**33.1**	51	**33.8**	24	**15.9**	20	**13.2**	6	**4.0**	151	**100**
7. Safety rules always describe the best way of working.	6	**4.0**	12	**7.9**	35	**23.2**	56	**37.1**	42	**27.8**	151	100
8. Sometimes I do not understand why I have to the follow safety procedures.	46	**30.5**	45	**29.8**	34	**22.5**	23	**15.2**	3	**2.0**	151	**100**
9. I feel like my safety matters to the organisation.	10	**6.6**	15	**9.9**	19	**12.6**	68	**45.0**	39	**25.8**	151	100
10. The blame for accidents is always placed on the injured employee.	20	**13.2**	43	**28.5**	37	**24.5**	28	**18.5**	23	**15.2**	151	**100**

Table 4.4 shows that **66.2%** (34.4% + 31.8%) do not accept as true that safety rules are used to protect management (DQ1), **68.2%** (29.1% + 39.1%) are in disagreement that acting with common sense is safer than following safety rules (DQ2)**, 73.5%** (37.7% + 35.8%) do not believe that safety rules should be broken to get the job done (DQ3) and **61.6%** (27.8% + 33.8%) are not of the opinion that safety rules make easy tasks complicated (DQ4). **77.6%** (54.4% + 23.2%) realise that they have a role to play as far as safety is concerned (DQ5) and **66.9%** (33.1% + 33.8%) disagree that safety rules remove skills (DQ6). **88.1%** (23.2% + 37.1% + 27.8%) specify that safety rules always describe the best way of working (DQ7), **60.3%** (30.5% + 29.8%) disagree that sometimes they do not understand why safety procedures have to be followed (DQ8). **83.4%** (12.6% + 45.0% + 25.8%) feel like their safety matters to the organisation (DQ9) while **58.2%** (24.5% + 18.5% + 15.2%) established that the blame for accidents is always placed on the injured employee (DQ10).

The third empirical objective was accomplished as the safety culture within the organisation was established. The majority of respondents displayed a very positive attitude towards the safety control measures and indicated their belief in the organisation caring about their safety.

4.4.1.5. Section E: Safety control measures and production cost

Table 4.5: Responses of participants based on their agreement or disagreement with the statements on safety control measures and production cost

Item description	***Strongly Disagree***		***Disagree***		***Moderately Agree***		***Agree***		***Strongly Agree***		***Total***	
	N	**%**	**n**	**%**	**n**	**%**	**N**	**%**	**n**	**%**	**n**	**%**
1. Safety control mechanisms increase production cost.	10	**6.6**	17	**11.3**	47	**31.1**	60	**39.7**	17	**11.3**	151	**100**
2. Safety measures at work have reduced the cost of fatalities.	8	**5.3**	5	**3.3**	41	**27.2**	51	**33.8**	46	**30.5**	151	**100**
3. Safety measures have reduced the costs in relation to accidents.	3	**2.0**	6	**4.0**	42	**27.8**	58	**34.8**	42	**27.8**	151	**100**
4. There is a high cost of employee replacement/substitution due to dismissals in relation to safety.	14	**9.3**	27	**17.9**	53	**35.1**	38	**25.2**	19	**12.6**	151	**100**
5. There is sufficient resource allocation to ensure adequate safety training.	4	**2.6**	11	**7.3**	50	**33.1**	49	**32.5**	37	**24.5**	151	**100**

6. Work injuries result in a high absenteeism rate.	13	**8.6**	20	**13.2**	44	**29.1**	56	**37.1**	18	**11.9**	151	**100**
7. Suspensions/dismissals result in the organisation paying overtime to the employees.	16	**10.6**	19	**12.6**	38	**25.2**	55	**36.4**	23	**15.2**	151	100
8. Safety measures have reduced the compensation paid to employees every year due to accidents.	11	**7.3**	21	**13.9**	34	**22.5**	62	**41.1**	23	**15.2**	151	**100**
9. Adequate safety procedures lead to less damage to property and equipment in the organisation.	2	**1.3**	10	**6.6**	37	**24.5**	59	**39.1**	43	**28.5**	151	100
10. Equipment lies idle due to injuries/suspensions/dismissals.	13	**8.6**	28	**18.5**	52	**34.4**	41	**27.2**	17	**11.3**	151	**100**
11. Failure to apply safety measures results in employees getting *suspended*.	6	**4.0**	10	**6.6**	42	**27.8**	65	**43.0**	28	**18.5**	151	**100**
12. Failure to comply with safety controls leads to employee *dismissa*l from work.	6	**4.0**	16	**10.6**	46	**30.5**	51	**33.8**	32	**21.2**	151	**100**
Item description	***Strongly Disagree***		***Disagree***		***Moderately Agree***		***Agree***		***Strongly Agree***		***Total***	
	N	**%**	**n**	**%**	**n**	**%**	**N**	**%**	**n**	**%**	**n**	**%**
13. Availability and correct use of PPE helps me to avoid work injuries.	0	**0**	6	**4.0**	25	**16.6**	74	**49.0**	46	**30.5**	151	**100**
14. There are safety incentives and bonuses to encourage employees to work safely.	0	**0**	6	**4.0**	18	**11.9**	60	**39.7**	67	**44.4**	151	**100**
15. Work accidents result in the loss of production.	7	**4.6**	7	**4.6**	27	**17.9**	65	**43.0**	45	**29.8**	151	**100**
16. My productivity has been affected by an injury I sustained at work.	35	**23.2**	26	**17.2**	22	**14.6**	47	**31.1**	21	**13.9**	151	**100**
17. Competent safety staff ensures a safe working environment.	2	**1.3**	4	**2.6**	23	**15.2**	70	**46.4**	52	**34.4**	151	100

18. Work accidents affect my morale leading to lower productivity.	9	**6.0**	16	**10.6**	33	**21.9**	59	**39.1**	34	**22.5**	151	**100**
19. I was hospitalised due to work injury.	69	**45.7**	29	**19.2**	15	**9.9**	19	**12.6**	19	**12.6**	151	100
20. The organisation provides adequate safety facilities.	6	**4.0**	10	**6.6**	28	**18.5**	65	**43.0**	42	**27.8**	151	**100**
21. The organisation was penalised due to lack of safety.	32	**21.2**	43	**28.5**	21	**13.9**	41	**27.2**	14	**9.3**	151	**100**
22. Employees leave the organisation due to lack of safety.	46	**30.5**	42	**27.8**	24	**15.9**	25	**16.6**	14	**9.3**	151	**100**
23. Small injuries should not be reported as they reduce safety bonuses.	71	**47.0**	29	**19.2**	13	**8.6**	27	**17.9**	11	**7.3**	151	**100**
24. The organisation has received an incentive from the government in relation to safety.	22	**14.6**	22	**14.6**	32	**21.2**	39	**25.8**	36	**23.8**	151	**100**

According to *Table 4.5*, EQ1 indicates that **82.1%** (31.1% + 39.7% + 11.3%) out of all the respondents **(151)** agree that safety control measures increase the production cost while only **17.9%** (6.6% + 11.3%) disagree with this statement. EQ2 – **91.5%** of the respondents (30.5% +33.8% + 27.2%) believe that safety measures have reduced the cost of fatalities at the Colliery. The results further indicate that for EQ3, majority of the respondents are of the opinion that safety measures have reduced costs due to accidents (27.8% + 38.4% + 27.8% = **94.0%**). However, the figures for EQ4 specify a high number of respondents in agreement with the high cost of employee replacement/substitution due to dismissals in relation to safety at the Colliery (**72.8% =** 35.1% + 25.2 + 12.6%) and EQ5 shows that **90.1%** (33.1% + 32.5% + 24.5%) of the respondents point out adequate resource allocation towards safety training.

Again, *Table 4.5* shows the participants' agreement with EQ6 which states that work injuries increase absenteeism rate (**78.1%** = 29.1% + 37.1% + 11.9%). **76.8%** (25.2% + 36.4% + 15.2%) support the statement that suspensions/ dismissals result in overtime payment (EQ7). EQ8 highlights the perceptions of the respondents who confirm that safety measures have reduced the compensation paid to employees due to accidents – **78.8%** (22.5% + 41.1% + 15.2%). With regard to EQ9, the majority of the respondents believe that adequate safety procedures lead to less damage to property and equipment within the organisation **– 92.1%** (24.5% + 39.1% + 28.5%). The high percentage of respondents in EQ10 agree that equipment lies idles due to injuries/suspensions/dismissals – **72.9%** (27.2% + 11.3% + 34.4%). Failure to apply safety measures results in employees getting suspended. This statement was supported by **89.3%** (27.8% + 43.0% + 18.5%) of the participants (EQ11). EQ12 - failure to comply with safety controls leads to employee dismissal from work. **85.5%** (30.5% + 33.8% + 21.2%) of the respondents agree with this statement. **96.1%** (16.6% + 49.0% + 30.5%) of the respondents believe that the availability and correct use of Personal Protective Equipment (PPE) helps them to avoid work injuries (EQ13). In EQ14 the respondents perceive that safety incentives and bonuses at their workplace encourage employees to work safely – **96.0%** (11.9% + 39.7% + 44.4%).

Furthermore, EQ15 suggested that work accidents result in the loss of production within the organisation and **90.7%** (17.9% + 43.0% + 29.8%) of the respondents are in support of the statement. A high number of participants in EQ16 are of the opinion that their productivity has been affected by an injury they sustained at work – **59.6%** (13.9% + 31.1% + 14.6%). The majority of respondents in EQ17 also believe that employment of competent safety staff ensures a safe working environment for the employees – **96%** (34.4% + 46.4% + 15.2%). **83.5%** (22.5% + 39.1% + 21.9%) indicated that work accidents affect their morale leading to lower productivity (EQ18). **64.9%** (45.7% + 19.2%) disagreed that they were hospitalised due to work injury (EQ19). **89.3%** (18.5% + 43.0% + 27.8%) stated that the organisation provides adequate safety facilities (EQ20). **49.7%** (21.2% + 28.5%) disagreed that the organisation was penalised due to lack of safety (EQ21) and **58.3%** (30.5% + 27.8%) also were against the statement that employees leave the organisation due to lack of safety (EQ22). Yet again, **66.2%** (47.0% + 19.2%) did not support the declaration that small injuries should not be reported as they reduce safety bonuses (EQ23). **70.8%** (21.2% + 25.8% + 23.8%) were for the statement that organisation has received an incentive from the government in relation to safety (EQ24).

The results indicate that the organisation is trying its best to maintain a safe working environment to ensure the safety of employees. The conclusion was based on the perceptions of the respondents who are the employees of the Colliery. This is evident due to the fact that the majority of the respondents indicated that there are adequate safety procedures and safety facilities within the Colliery. The Colliery ensures that PPE is available and used correctly, there are incentives to encourage the employees to work safely, competent safety staff as well as sufficient resource allocation to ensure that the employees are well-trained in relation to safety. It is therefore apparent in the results that these employees are well-trained (EQ5) and understand their responsibilities as a high number of respondents made known that although small injuries reduce their safety bonuses, it is still their responsibility to report them. Due to the fact the Colliery is trying so hard to ensure safety, it is able to retain its employees as they feel safe at the organisation (EQ22). Hence the results in EQ21 that there have not been any penalties charged against the Colliery in relation to safety. Furthermore, the employees perceive that safety measures have reduced fatalities, costs in relation to accidents, compensation paid to employees due to accidents, reduced property damage and reduced number of injuries due to provision of PPE by the Colliery.

Nevertheless, the Colliery is still incurring costs due to lack of safety as espoused by the Indirect Cost Theory of Accident Prevention. These include replacement costs due to dismissals (EQ4), suspensions (EQ11), overtime paid because of suspensions and dismissals(EQ7), high absenteeism rate (EQ6), idle equipment (EQ10), loss of production (EQ15) and reduced employee productivity (EQ16) and morale (EQ18) due to injuries as perceived by the employees. However; according to the above mentioned theory, these costs can be reduced or avoided through continuous application of safety measures and procedures.

The participants also made it clear that the organisation is investing in safety; (EQ5), sufficient resource allocation to ensure safety training; (EQ9) adequate safety procedures; (EQ13) availability of PPE; (EQ14) safety incentives and bonuses; (EQ17) competent safety staff and (EQ20) adequate safety facilities. Hence the results in EQ1 demonstrated that the majority of the respondents are certain that safety controls increase the production cost. This is consistent with the suggestions of Safety Control Cost Theory which emphasizes that the more the investments in relation to safety, the higher the level of safety to be achieved which will result in the reduction of costs in the long run due to smaller chances of accident occurrence. This is confirmed by the results conveyed in EQ2, EQ3, EQ8, EQ9 and EQ13. Therefore; empirical objective four has been achieved.

4.4.2. Descriptive analysis

Table 4.6: Measures of central location, dispersion, shape and 'peakedness'

Section	N	Mean	Std. Deviation	Skewness	Kurtosis
B	151	4.17	0.53	-0.58	0.81
C	151	2.67	0.69	0.58	0.44
D	151	2.56	0.69	0.89	0.35
E	151	3.41	0.54	0.36	-0.49

Mean is the measure of central tendency that indicates the average score or the value that lies at the centre of a set of numerical data. The study made use of a 5-point Likert scale instrument for all sections (B-E). Section B ranked the highest with the mean score of 4.17 which shows that on average; the respondents' scores were between agree and strongly agree (Dhurup & Mafini 2012:142). This indicates that the majority of participants perceive that the Colliery is compliant with the relevant safety legislations. To establish whether or not the mean accurately represents the data; the standard deviation was computed. Standard deviation expresses the dispersion of data around the mean in order to establish how well the mean represents the data. If the mean represents the data; the scores will cluster around the mean. That is; the value of the standard deviation will be small. This consequently indicates that the larger the standard deviation the greater the distance is of the data points from the mean (Field 2009:38). *Table 4.6* reflects small standard deviations relative to the mean for sections B to E. It can therefore be concluded that the mean discloses the accurate representation of the respondents' scores and as a result it is a good fit for the data.

The data was further analysed for skewness and kurtosis. Skewness measures the degree of departure from the symmetry within the data while kurtosis measures the degree of peakedness of the distribution. The values of skewness and kurtosis should be zero when the data is normally distributed. Wegner (2012:83) concurs that the rule of thumb for skewness states that the coefficient below -1 or above +1 indicates excessive skewness due to extreme outliers within the data. Skewness results shown in *Table 4.6* range from -0.58 to + 0.89 which are within -1 and +1.

This shows moderate skewness and it can therefore be inferred that the data tend to be approximately evenly spread about the mean score (Werner 2009:270). The outcomes of kurtosis as well for all sections range between -0.49 and + 0.81 which are also within the range of -1 and +1 and as a result establish a moderate concentration of data around the mean (Van der Vaart, Linde & Cockeran 2013:362). Although positive results were obtained regarding the mean, skewness and kurtosis the data was further analysed to determine whether the instruments under each section were measuring the same thing using the Exploratory Factor Analysis (EFA). EFA was done to reach the fifth empirical objective, namely to identify sensible managerial focus points with regard to safety control mechanisms and production cost.

4.4.3. Exploratory Factor Analysis (EFA)

EFA is a statistical technique or method that is used to measure things that are not directly measured by establishing underlying dimensions named latent variables without determining the extent to which the results fit a certain model (Bryman & Cramer 2011:319). It reduces a large number of variables in the scale and group them into a set of variable named factors. This is done by determining which items belong together because they are answered the same way or they are measuring the same concept. It therefore, evaluates and establishes the validity of the instrument by providing evidence for construct validity (Masia & Pienaar 2011:941). The data was determined for factorability through an inter-item correlation matrix. The correlation matrix was computed to determine the relationship between individual variables. It revealed the correlation between some items of less than 0.30, which was an indication that the instruments were not measuring the same thing (Williams 2010:5). Additionally, the instrument used a 5-point Likert scale as mentioned earlier and items measured on a 5-point or 7-point Likert scale with a sample size greater than 100 were found suitable for factor analysis (Williams 2010:4).

4.4.3.1. Extraction and naming of factors

The scale had five sections – A to E. Only questions under section B to E were used for factor analysis as section A consisted of general information questions. Section B consisted of 12 items, section C had 10 questions, section D comprised 10 variables while Section E contained 24 items. In order to determine the number of significant dimensions within the variables; the Principal Component Analysis (PCA) was applied. It was utilised to extract factors and as a data reduction procedure applied on 56 items which resulted in 49 retained items grouped into factors. To establish the number of factors under each section; eigenvalues were examined. The study followed Kaiser's criteria to extract factors – eigenvalue >1 rule and the Scree test (Williams 2010:6). The decision to use the eigenvalue rule – with the results indicated in *Table 4.7* - was also supported by Maree (2007:219) who argues that,

> "….there are as many factors as the number of eigenvalues greater than 1."

Under section B and C two factors were identified, three under section D and six under section E as shown in the scree plots - *Figure 4.8* to *4.11* - and eigenvalues highlighted in the tables (from *Table 4.7* to *4.10)*. It was then established which questions loaded on these factors and rotated using Varimax with Kaiser Normalization to improve the loadings of these questions. The rotated component matrix revealed items that loaded on more than one factor, those that loaded below 0.5 and the factors that loaded less than three items. Only variables whose loadings were greater than 0.5 were accepted. Factors with less than three items were rejected due to the declaration by Varonen and Mattila (2000:763) that it takes at least three variables to define a factor. The items that loaded on more than one factor and were all below 0.5 were also rejected in order to simplify and improve the interpretability of factors (Field *et al.* 2013:765).

Nonetheless; the questions which loaded on more than one factor were allowed to represent the factor with the highest loading provided the loading is >0.5 (O'Toole 2002:237). Grounded on the aforesaid; all two factors were retained under section B and C but only one out of three factors was accepted under section D due to the fact that the two rejected factors had less than three items. Four out of six factors under section E were accepted and Cronbach's alpha was calculated for all extracted and retained factors. They were all above the acceptable level of 0.70 except for two factors which were below the benchmark level (0.49 and 0.44). Hence the results reported in *Table 4.11*. The factors are numbered according to sections and number of factors retained in each section from section B to section E. For example; the factor that is numbered BF1, indicates that it is factor 1 under section B.

Table 4.7: Total Variance Explained: Section B

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings	
	Total	% of Variance	Cumulative %	Total	% of Variance
1	**5.90**	**49.19**	**49.19**	**5.39**	**44.95**
2	**1.47**	**12.27**	**61.46**	**1.98**	**16.51**
3	0.90	7.53	68.99		
4	0.76	6.37	75.35		
5	0.55	4.54	79.89		
6	0.48	4.04	83.93		
7	0.42	3.53	87.46		
8	0.38	3.17	90.64		
9	0.35	2.92	93.56		
10	0.32	2.63	96.19		
11	0.26	2.15	98.34		
12	0.20	1.66	100.00		

Plot of eigenvalues: Section B

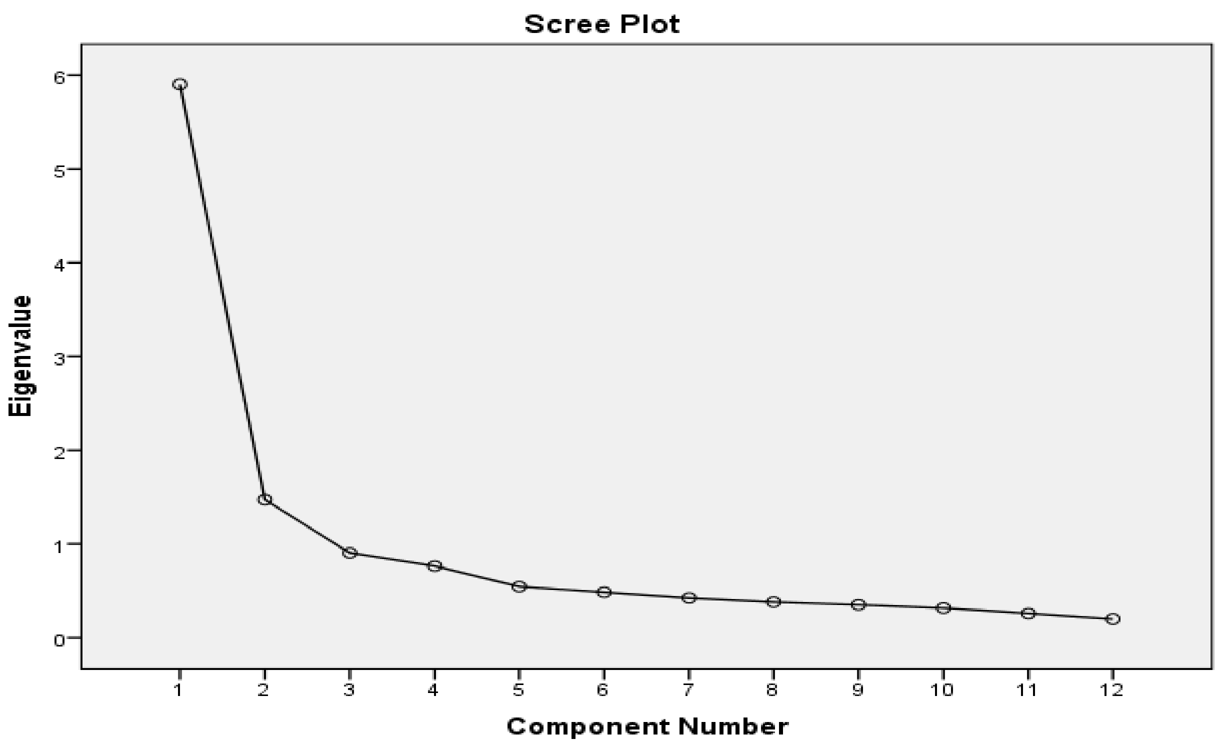


Figure 4.8

Table 4.8: Total Variance Explained: Section C

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings	
	Total	% of Variance	Cumulative %	Total	% of Variance
1	**4.19**	**41.91**	**41.91**	**4.18**	**41.83**
2	**1.78**	**17.78**	**59.69**	**1.79**	**17.86**
3	0.87	8.69	68.38		
4	0.81	8.07	76.45		
5	0.56	5.60	82.05		
6	0.52	5.24	87.29		
7	0.48	4.77	92.06		
8	0.33	3.28	95.34		
9	0.25	2.54	97.87		
10	0.21	2.13	100.00		

Plot of eigenvalues: Section C

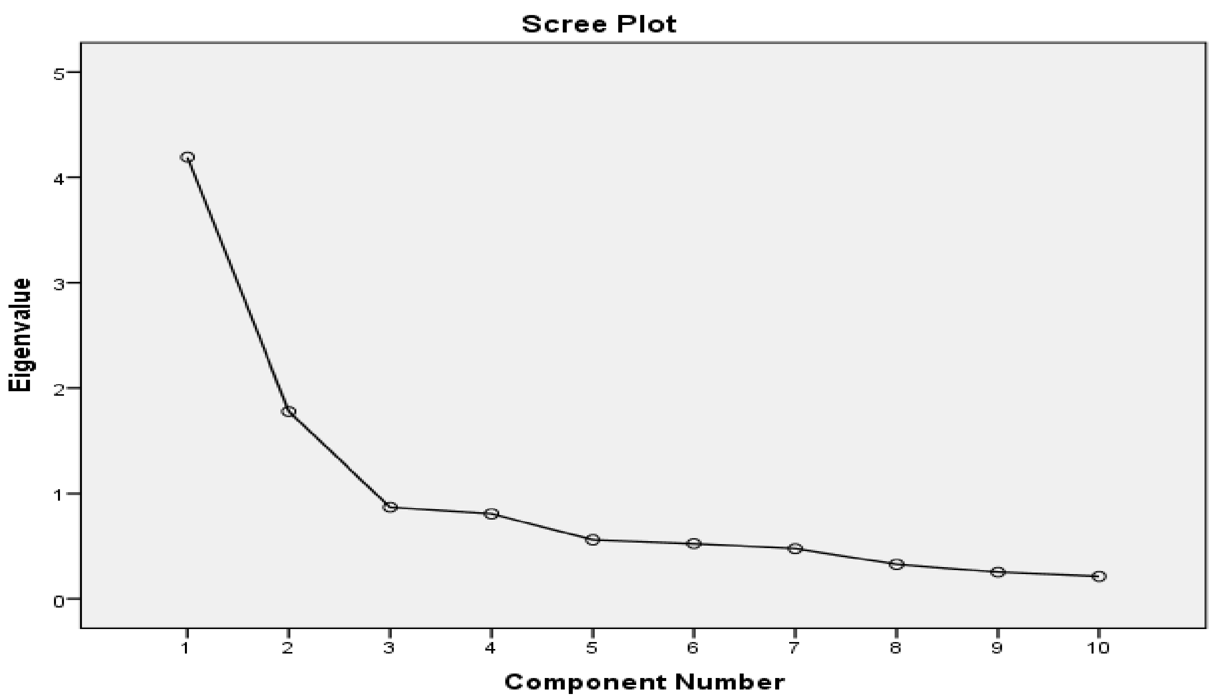


Figure 4.9

Table 4.9: Total Variance Explained: Section D

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings	
	Total	% of Variance	Cumulative %	Total	% of Variance
1	**4.60**	**45.95**	**45.95**	**4.28**	**42.79**
2	**1.24**	**12.35**	**58.31**	**1.33**	**13.28**
3	**1.09**	**10.93**	**69.23**	**1.32**	**13.16**
4	0.91	9.09	78.33		
5	0.58	5.77	84.09		
6	0.47	4.69	88.78		
7	0.40	3.95	92.73		
8	0.31	3.10	95.83		
9	0.25	2.45	98.29		
10	0.17	1.71	100.00		

Plot of eigenvalues: Section D

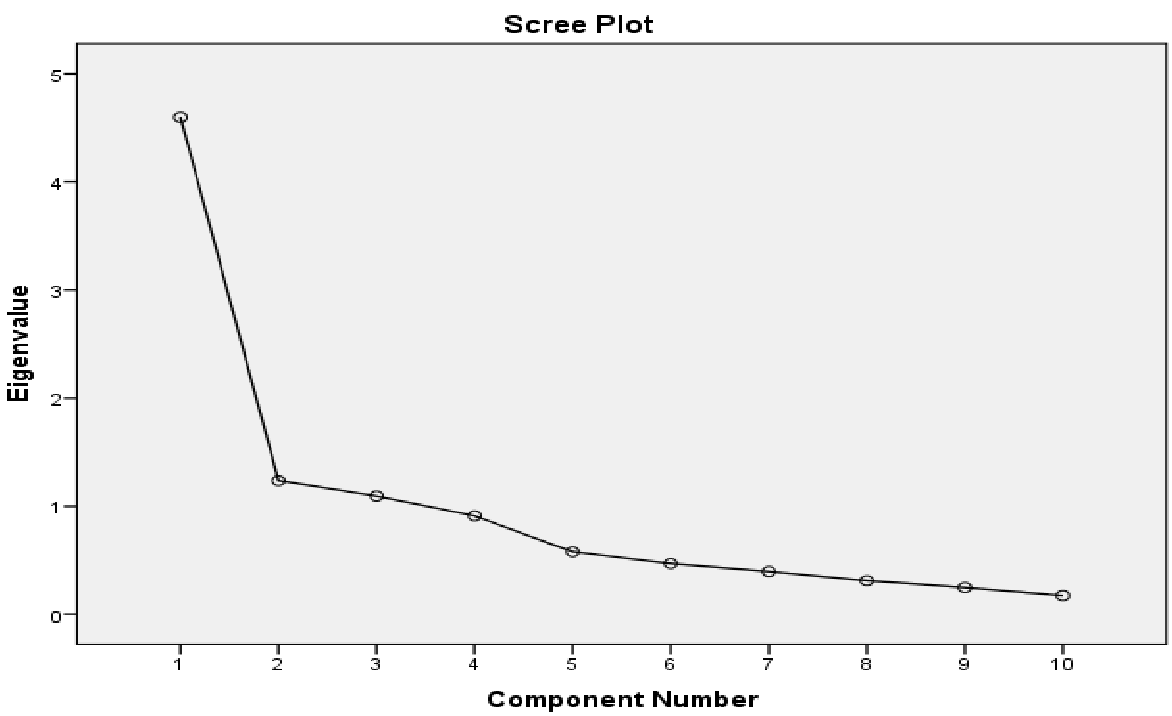


Figure 4.10

Table 4.10: Total Variance Explained: Section E

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings	
	Total	% of Variance	Cumulative %	Total	% of Variance
1	**6.09**	**25.36**	**25.36**	**3.95**	**16.44**
2	**3.24**	**13.51**	**38.87**	**3.88**	**16.17**
3	**2.31**	**9.63**	**48.51**	**3.01**	**12.52**
4	**1.89**	**7.89**	**56.39**	**2.06**	**8.57**
5	**1.19**	**4.96**	**61.35**	**1.66**	**6.93**
6	**1.02**	**4.25**	**65.60**	**1.19**	**4.98**
7	0.89	3.71	69.31		
8	0.85	3.53	72.84		
9	0.69	2.88	75.73		
10	0.68	2.84	78.56		
11	0.64	2.66	81.23		
12	0.59	2.47	83.70		
13	0.56	2.32	86.02		
14	0.50	2.07	88.09		
15	0.42	1.75	89.84		
16	0.40	1.65	91.48		
17	0.37	1.53	93.01		
18	0.34	1.40	94.41		
19	0.31	1.30	95.71		
20	0.27	1.14	96.85		
21	0.25	1.05	97.89		
22	0.19	0.78	98.66		
23	0.18	0.73	99.41		
24	0.14	0.59	100.00		

Plot of eigenvalues: Section E

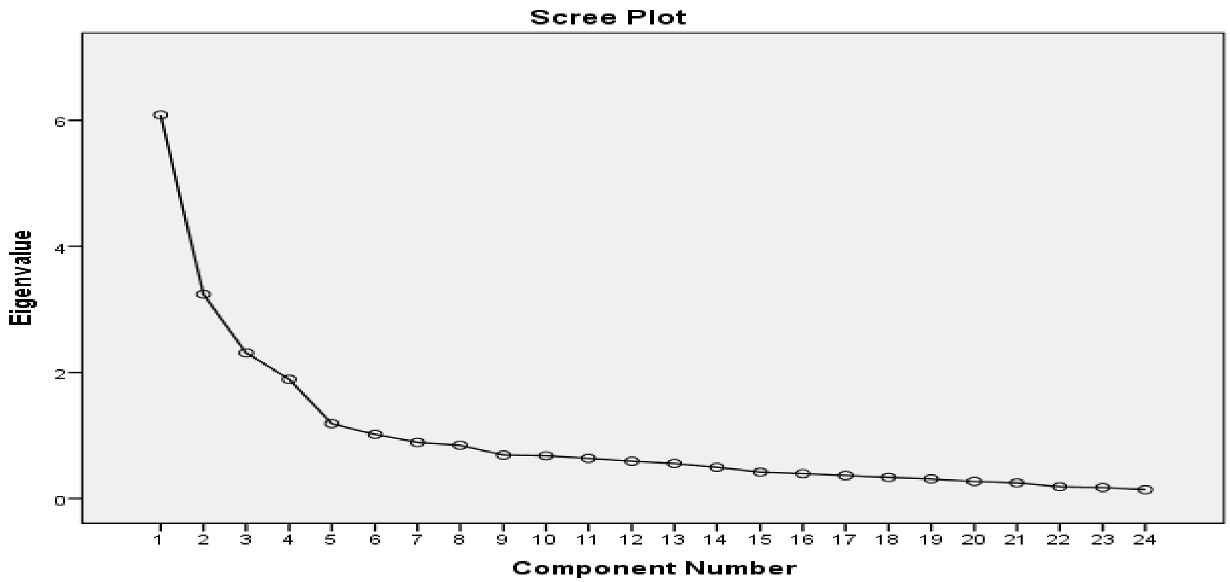


Figure 4.11

Table 4.11: Factors extracted and rotated factor loadings

Section	Factor and variable description	Factor 1	Factor 2	Factor 3	Factor 4
BF1	**Compliance with safety legislation**				
	The organisation is up to date with the safety legislation.	0.72			
	There is a safety policy regarding the safety of employees.	0.84			
	There are safety measures to ensure the safety of employees.	0.87			
	Employees are made aware of possible hazards associated with their jobs.	0.85			
	There are safety procedures to guide the performance of tasks.	0.81			
	There are regular safety control meetings.	0.74			
	Effective documentation ensures the availability of safety procedures.	0.63			
	Personal protective equipment (PPE) is provided freely at all times.	0.72			
	Management learns from past mistakes and implements corrective measures.	0.61			
BF2	**Management commitment to safety**				
	Safety representatives are involved in putting together the safety procedures.		0.70		
	Management considers safety to be equally as important as production.		0.77		

	Supervisors seldom discipline employees who break the safety rules.		0.60		
	% of variance explained	***49.19***	***12.27***		
	Cumulative % 61.46				
	Reliability (Cronbach's alpha)	**0.92**	***0.49***		
CF1	**Employees' compliance and commitment to safety**				
	I often deviate from safety rules.	0.62			
	Some safety rules are impossible to apply.	0.76			
	There are too many safety rules that one cannot remember.	0.74			
	Safety rules are only for inexperienced workers.	0.83			
	I can get the job done quicker by ignoring the safety rules.	0.83			
	Sometimes I fail to understand which rules to apply.	0.75			
	I have difficulty getting hold of written safety rules.	0.77			
Section	**Factor and variable description**	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
CF2	**Supportive work environment**				
	I have found better ways of doing my job.		0.66		
	Safety rules are written in the language that I understand well.		0.75		
	Employees often give tips on how to work safely.		0.78		
	% of variance explained	***41.91***	***17.78***		
	Cumulative % 59.69				
	Reliability (Cronbach's alpha)	***0.86***	***0.44***		
DF	**Employee's perceptions on safety culture**				
	Safety rules are used only to protect management's back.	0.65			
	Acting with common sense is safer than acting within safety rules.	0.84			
	It is necessary to break the safety rules to get the job done.	0.86			
	Safety rules make easy tasks complicated.	0.77			
	Safety is not my role.	0.87			
	Working safety rules remove skills.	0.68			
	Sometimes I do not understand why I have to follow the safety procedures.	0.73			

	% of variance explained ***Cumulative % 45.95*** ***Reliability (Cronbach's alpha)***	***45.95*** ***0.90***			
EF1	**Perceptions of indirect cost of work accidents and injuries** Work injuries result in a high absenteeism rate. Suspensions/dismissals result in the organisation paying overtime to the employees. Safety measures have reduced the compensation paid to employees every year due to accidents. Equipment idles due to injuries/suspensions/dismissals. Failure to apply safety measures results in employees getting suspended. Failure to comply with safety controls leads to employee dismissal from work. Work accidents result in the loss of production.	0.73 0.75 0.51 0.69 0.60 0.63 0.71			
Section	**Factor and variable description**	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
EF2	**Perceptions in relation to direct cost of unsafe environment** My productivity has been affected by an injury I sustained at work. I was hospitalised due to work injury. The organisation was penalised due to lack of safety. Employees leave the organisation due to lack of safety. Small injuries should not be reported as they reduce safety bonuses. The organisation has received an incentive from the government in relation to safety.		0.66 0.81 0.79 0.84 0.81 0.57		
EF3	**Work environment in relation to safety** Availability and correct use of PPE helps me to avoid work injuries. There are safety incentives and bonuses to encourage employees to work safely. Competent safety staff ensures a safe working environment for the employees.			0.73 0.74 0.55	

	The organisation provides adequate safety facilities.			0.67	
EF4	**Perceptions on cost reduction due to adherence to safety measures and procedures**				
	Safety measures at work have reduced the cost of fatalities.				0.90
	Safety measures have reduced the costs in relation to accidents.				0.66
	Adequate safety procedures lead to less damage to property and equipment in the organisation.				0.56
	% of variance explained				
	Cumulative % 56.39	***25.36***	***13.51***	***9.63***	***7.89***
	Reliability (Cronbach's alpha)	***0.84***	***0.87***	***0.68***	***0.71***

4.4.3.2. Interpretation of factors

The first dimension (**BF1**) was named ***Compliance to safety legislation*** and consisted of nine items. According to Griffin and Neal (2000:349) compliance to safety legislation describes the activities that are carried out by individuals within organisations in accordance with the legislative guidelines to ensure and maintain workplace safety. This may include implementation of safety measures, devotion to the application of safety rules and procedures as well as the use of Personal Protective Equipment (PPE). While Yapp and Fairman (2005:150) contend that compliance refers to "conformity with the law". The law provides regulations, standards and guidelines that are promulgated to ensure that the mining industry operates safely. It indicates the dos and don'ts that must be followed to ensure conformity with the law and to avoid penalties (Poplin *et al.* 2008:1197). Through compliance, regulators are enabled to control the behaviour of the organisations by imposing the legislative requirements on them to ensure that the mining operations are carried out according to the requirements of the law (Yapp & Fairman 2005:151).

BF2 which was made up of three items was named ***Management commitment to safety.*** Michael, Evans, Jansen and Haight (2005:177) define management commitment to safety as the dedication and loyalty of management to safety and concern for employees' well-being. This is evident in organisations where management abides by the law and ensures that all the requirements of the law are observed and complied with. It includes management's involvement in safety by showing keenness and commitment to providing safety facilities and maintaining a safe working environment for their employees. Abudayyeh, Fredercks, Butt and Shaar (2006:168) maintain that there is a direct relationship between management commitment and a safe working environment and this is confirmed by Michael *et al.* (2005:172-176) who established that management commitment has an impact on the behaviour and attitude of employees towards safety. Strong management commitment is said to have a positive influence on compliance of employees with applicable safety procedures and results in a better employee safety performance (Masia & Pienaar 2011:939). If the employees perceive that management is dedicated, supportive and has concern for their well-being, they are likely to recognise that the organisation values their safety. This may encourage the employees to commit to safety through application of safety controls to ensure their own safety and maintain a safe working environment (Neal, Griffin & Hart 2000:100).

CF1 was named ***Employees' compliance and commitment to safety*.** This factor was represented by seven items. Neal *et al.* (2000:101) explain safety compliance as adherence, devotion or dedication of employees to carrying out tasks in accordance with the applicable safety rules and procedures which indicates the performance of duties in a safe manner. For this to be possible; employees must have the understanding of how to perform work safely, therefore training must be provided to ensure that the employees have the skills required to perform that particular work. This is in agreement with Masia and Pienaar (2011:939) who emphasized that safety compliance denotes the willingness of employees to follow the safety rules and procedures in the performance of their daily tasks and duties in order to avoid accidents and incidents. As a result, employees that are determined to comply and adhere to safety rules identify with their organisations and ensure that the set safety goals are achieved.

CF2 was categorised as ***Supportive work environment*** and has three items. This designates the environment where there is support and encouragement to comply with and adhere to safety rules and procedures. This would be an environment where safety is the norm, where there is support in relation to safety from management and other employees and this norm is accepted by all individuals within the organisation (Brown, Raynor & Lee 2011:56). This was confirmed and validated by the study conducted by Cox and Chayne (2000:121).

The only factor (**DF**) that was retained under Section D as explained in *4.4.3*, was made up of seven items. It was named ***Employee's perceptions on safety culture*** which signifies a set of learned values, shared attitudes, beliefs, morals, capabilities and habits acquired by individuals which are reflected through the behaviour of individuals in the workplace (Harvey *et al.* 2002:18). These shared attitudes, beliefs, values, ideas and practices interpreted through rules and norms of behaviour have an impact on the employees' exposure to risk and therefore they determine the safety culture of the organisation (Strahan, Waltson & Lennonb 2008:420). Flin (2007:656) is confident that individual or group attitudes, values, perceptions, competencies and behaviour determine commitment to, style and proficiency of organisational health and safety management. He further maintains that the positive organisational culture opens communication channels and creates mutual trust between employees and management. In the long run; these may result in all individuals within the organisation sharing the same perceptions with regard to the importance of safety and therefore build confidence in the effectiveness of preventative measures.

Furthermore; four factors were identified under Section E. **EF1** was labelled ***Perceptions of indirect cost of work accidents and injuries*** consisting of seven items. Indirect costs also called 'hidden costs' are the costs incurred due to accidents but which cannot directly be attributed to the accident. They are not easily measured and are therefore borne by the employer as they are not covered and refunded by the insurance (Rikhardsson & Impgaard 2004:173).

The second component (**EF2**) was entitled ***Perceptions in relation to direct cost of unsafe environment,*** made up of six variables. This is the environment where employees operate in an unsafe behaviour which results in accidents. Costs incurred due to these accidents which are directly attributable to the particular accident, easily measured, covered and refunded by the insurance are referred to as direct costs (Rikhardsson & Impgaard 2004:173-174).

EF3 was labelled ***Work environment in relation to safety*** which has four questions. Kidd, Miner, Walker and Davidson (2007:22) describe a good and safe working environment as the one in which employees are supportive of one another in relation to safety. This relates to their openness towards one another as well as the availability of discussions and processing of their experiences. An environment where information is shared, supervision is good and support is always accessible to all individuals within the organisation. Gershon, Karkashian, Grosch, Murphy, Escamilla-Cejudo, Flanagan, Bernacki, Kasting and Martin (2000:212) are of the opinion that a safe work environment is the one that supports individual safety behaviour which will further influence the behaviour of other employees.

EF4 was called ***Perceptions on cost reduction due to adherence to safety measures and procedures*** which comprises three instruments. It was stated earlier in this chapter that compliance refers to the devotion to safety rules and procedures and the carrying out of every- day duties in a safe manner (Neal *et al.* 2000:101). If duties are carried out in a safe manner and in accordance with applicable safety measures, this can result in a perfect state of safety within the organisation. This in turn can result in no accidents and therefore no costs associated with accidents will be incurred (Son, Melchers & Kal 2000:188).

The questionnaire included 56 perception based questions which were reduced to nine sensible managerial focus points. Therefore the fifth empirical objective was achieved.

Further analysis was carried out on the data to determine the differences in the responses of the participants in relation to the above factors, hence the computation of Analysis of Variance or Difference (ANOVA) for three groups and t-test for two groups.

4.4.4. ANOVA and t-test

ANOVA and t-test are statistical procedures conducted to determine if the group means are equal. If there are any differences between group means; ANOVA indicates the significance of the differences that exist between the group means (Clow & James 2014:413-414). Data for this study was collected using the stratified random sampling due to differences in the employees' exposure to risks as highlighted in Chapter 3. It was conducted to establish perception differences between employees within different departments, years of experience, designation, English proficiency, gender and qualification. For the purpose of this study, the employees within departments were grouped into three strata, (1) Administration, (2) Mining and Plant as well as (3) Engineering and Technical services. ANOVA was found appropriate for the study as it establishes variances between three or more groups (Cooper & Phillips 2004:502). Based on the group differences in relation to risks; the group means were compared to determine whether there are any variances between administrative staff who work in offices and the employees especially those who work in the mine and plant. The differences between and within strata as well as the significance of these differences were established using One-way ANOVA. These differences were considered significant if the P-value was less than or equal to 0.05 while the P-value greater than 0.05 was considered not to be statistically significant.

The variances were determined between strata in order to determine whether or not the employees and administrative staff have the same perceptions on the issues of compliance of the Colliery with the safety legislation (BF1), management commitment to safety (BF2), employees' compliance and commitment to safety (CF1), supportive work environment (CF2), employees' perceptions on safety culture (DF), perceptions of indirect cost of work accidents and injuries (EF1), perceptions in relation to direct cost of unsafe work environment (EF2), work environment in relation to safety EF3) and cost reduction due to adherence to safety measures and procedures (EF4). *Table 4.12* shows the results of mean comparisons according to different departments to determine whether they were equal or not - Engineering and technical services (Eng. + Tech. services), Mining and Plant (Mining + Plant) and Administration (Admin.). If group means are different they will be in either subset one or subset two of the homogenous tables but if they are equal then they will share the same subset which is an indication that the means are not different. ANOVA was then used to establish the significance of the variances where they were noted and post-hoc testing for multiple comparisons was computed to establish exactly where significant differences were found (Naidoo & Maseko 2012:113). The results below highlight the differences discovered between departments and are reported in *Table 4.13* and *Table 4.14.*

4.4.4.1. Differences identified between departments

Table 4.12: Mean comparisons for departments in homogeneous subsets

		B Total		B Factor 1		B Factor 2		E Factor 3	
Department	**N**	**Subset 1**	**Subset 2**	**Subset 1**	**Subset 2**	**Subset 1**	**Subset 2**	**Subset 1**	**Subset 2**
Mining + Plant	63	3.95		4.05		3.66		4.00	4.00
Eng. + Tech. services	33		4.21	4.26	4.26		4.03	3.85	
Admin	55		4.41		4.53		4.04		4.26

Table 4.12. Continues

		D Total		C Factor 1		D Factor		E Factor 2	
Department	**N**	**Subset 1**	**Subset 2**	**Subset 1**	**Subset 2**	**Subset 1**	**Subset 2**	**Subset 1**	**Subset 2**
Admin.	55	2.24		2.05		1.89		2.33	
Eng. + Tech. services	33	2.32	2.32	2.31	2.31	2.05	2.05	2.55	2.55
Mining + Plant	63		2.66		2.55		2.48		3.00

Table 4.12. Continues

		C Total	E Total	C Factor 2	E Factor 1	E Factor 4
Department	**N**	**Subset 1**	**Subset 1**	**Subset 1**	**Subset 1**	**Subset 1**
Eng. + Tech. services	**33**	2.54	3.29	3.08	3.38	3.69
Mining + Plant	**63**	2.72	3.34	3.26	3.43	3.77
Admin.	**55**	2.76	3.52	3.32	3.58	4.03

Table 4.13: Mean differences as revealed by ANOVA according to different departments

Adherence or compliance to safety legislation = [F(2,15) = 12.58, p = 0.00]		**Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**
B Total	Between groups Within groups	6.12 36.02	2 148	3.06 0.24	12.58	* 0.00
Total		**42.14**	**150**			
Employees' adherence regarding the application of safety control measures [F(2,145) = 5.57, p = 0.01]						
D Total	Between groups Within groups	5.73 76.23	2 148	2.87 0.52	5.57	* 0.01
Total		**81.96**	**150**			
Compliance to safety legislation [F(2,15) = 11.19, p = 0.00]		**Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**
B Factor 1	Between groups Within groups	6.70 44.32	2 148	3.35 0.30	11.19	* 0.00

Total	**51.02**	**150**			
Management commitment to safety [F(2,15) = 5. 25, p = 0.01]					
B Factor 2 Between groups Within groups	5.36 75.42	2 148	2.68 0.51	5.25	* 0.01
Total	**80.78**	**150**			
Employees' compliance and commitment to safety = [F(2,15) = 4.95, p = 0.01]					
C Factor 1 Between groups Within groups	7.39 110.56	2 148	3.70 0.75	4.95	* 0.01
Total	**117.95**	**150**			
Employees' perception on safety culture [F(2,15) = 7.03, p = 0.00]					
D Factor Between groups Within groups	10.57 111.06	2 148	5.29 0.75	7.04	* 0.00
Total	**121.63**	**150**			
Indirect cost of unsafe environment [F(2,15) = 6.36, p = 0.00]					
E Factor 2 Between groups Within groups	13.47 156.76	2 148	6.73 1.06	6.36	* 0.00
Total	**170.23**	**150**			
Work environment in relation to safety [F(2,15) = 5.39, p = 0.01]					
E Factor 3 Between groups Within groups	4.02 55.11	2 148	2.01 0.37	5.39	* 0.01
Total	**59.12**	**150**			

* Significant at the 0.05 level.

Findings of ANOVA as exposed in *Table 4.13*, highlight statistically significant results (indicated with an asterisk star *) identified between the responses of employees in different departments. In order to establish exactly where the differences were found; post-hoc test for multiple comparisons was performed and the results are reported in *Table 4.14*.

Table 4.14: Post-hoc results using the Turkey HSD test

Departmental variances	Departments		Mean differences	Std. error	Sig.
B Total	Mining + Plant	Eng. + Tech. services Admin.	-0.25 -0.45	0.11 0.09	* 0.05 * 0.00
D Total	Mining + Plant	Eng. + Tech. services Admin	0.34 0.42	0.15 0.13	0.08 * 0.01
B Factor 1	Mining + Plant	Eng. + Tech. services Admin.	-0.22 -0.48	0.12 0.10	0.16 * 0.00
B Factor 2	Mining + Plant	Eng. + Tech. services Admin.	-0.37 -0.39	0.15 0.13	* 0.04 * 0.01
C Factor 1	Mining + Plant	Eng. + Tech. services Admin.	-0.24 -0.50	0.19 0.16	0.41 * 0.01
D Factor	Mining + Plant	Eng. + Tech. services Admin.	0.34 0.42	0.19 0.16	0.06 * 0.00
E Factor 2	Mining + Plant	Eng. + Tech. services Admin.	0.45 0.66	0.22 0.19	0.11 * 0.00
E Factor 3	Admin.	Eng. + Tech. services Mining + Plant	0.42 0.27	0.13 .11	* 0.01 * 0.05

* The mean significance at 0.05 level.

B Total (*<u>Adherence or compliance of the Colliery to safety legislation</u>*): The post-hoc comparison using Turkey HSD test indicated that the mean score for Engineering + Technical services (M = 4.21, SD = 0.42) and Administration (M = 4.41, SD = 0.43) were significantly different from Mining + Plant (M = 3.95, SD = 0.58) in relation to adherence of the Colliery to the safety legislation. Administration includes top management and those responsible for resource allocation as highlighted earlier in chapter 3. One plausible reason for this difference could be that the miners perceive that certain safety concerns are disregarded due to inadequate resources (time, money and personnel) and therefore conclude that the organisation does not comply with the legislation as shown and confirmed by the low mean in this department. O'Toole (2002:232) specified that management struggles with how best the resources should be allocated to achieve the greatest accident reduction as opposed to production enhancing activities.

D Total (*<u>Employees' perceptions and attitude towards safety controls</u>*): The score for Engineering + Technical services (M = 2.32, SD = 0.57) did not differ significantly from Mining + Plant (M = 2.66, SD = 0.78). However; a significant difference was noted between Mining + Plant and Admin (M = 2.24, SD = 0.71). Administration shows the lowest mean while Mining +

Plant shows the highest mean regarding their perceived safety culture. A possible reason could be that there is a belief among the administrative staff that miners break rules intentionally which is consistent with Laurence's finding (2005:39) that miners are convinced that if the organisation operates 100% within rules it will never produce even a single tonne of coal and therefore rules need to be broken in order to get the job done.

B Factor 1 *(<u>Compliance with safety legislation</u>):* Engineering + Technical services (M = 4.26, SD = 0.48) did not show any difference when compared to Mining + Plant (M = 4.05, SD = 0.64) but revealed a significant difference when compared to Administration (M = 4.53, SD = 0.46). Again Mining + Plant show the lowest mean in relation to the compliance of the organisation with safety legislation. It was established in the study conducted by Gyekye (2003:534-535) that for decades mining has been considered to be the most dangerous job due to high fatality and disabling injury rate. The results of this study (Gyeke) revealed that when miners were compared to their counterparts in other industries (33%); the high percentage of miners (81%) perceived their job environments to be hazardous and dangerous. Based on this, it can be concluded that miners may feel that the organisation is not doing enough to ensure their safety and to conform to the requirements of the law.

B Factor 2 *(<u>Management commitment to safety</u>):* Differences were noted between groups as per the post-hoc test regarding management commitment, as shown in *Table 4.14*. When the mean scores for Engineering + Technical services (M = 4.03, SD = 0.55) and Administration (M = 4.04, SD = 0.66) were compared with Mining + Plant (M = 3.66, SD = 0.83) statistically significant variances were identified. It could be concluded that Mining + Plant believes that management is not 'walking the talk' and that it does not show dedication and support for safety by demonstrating of safety leadership (O'Toole 2002:233). Laurence (2205:39-41) stated that people at the top just give lectures indicating the importance of safety and how accidents are unacceptable without determining the root cause of the violation of rules by the operators. He concurs that there are always good reasons why rules are being violated and it is the responsibility of the people at the top to find these reasons to enable them to change the system and procedures.

C Factor 1 *(<u>Employees' compliance and commitment to safety</u>):* The post-hoc test highlighted the variances in the table above between Mining + Plant (M = 2.31, SD = 0.79) and Administration (M = 2.05, SD = 0.83) but there were no significant differences found between Mining + Plant and Engineering + Technical services (M = 2.55, SD = 0.93) based on the employees' compliance and commitment to safety. One probable reason being that it is believed that the high number of accidents that occur in workplaces, especially in the mining industry, are attributable to human error and miners failing to follow safety rules and regulations due to illiteracy or due to ignorance (Masia & Pienaar 2011:938).

D Factor *(<u>Employees' perceptions on safety culture</u>):* There were no significant differences found when Mining + Plant (M = 2.48, SD = 0.93) was compared with Engineering + Technical services (M = 2.05) yet Mining + Plant and Administration (M = 1.89, SD = 0.88) differed significantly on the issue of perceived safety culture. This refers to the shared perceptions, values, beliefs and most importantly attitudes which are often based on all other contributory features of the working environment. This difference could be an indication that the respondents in these departments do not share the same perceptions, beliefs and attitudes in relation to safety within the organisation as they are not exposed to the same risks (Siu, Phillips & Leung 2004:359).

E Factor 2 *(<u>Perceptions in relation to direct cost of unsafe work environment</u>):* The results above show a significant difference between Mining + Plant (M = 3.00, SD = 1.06) and Administration (M = 2.33, SD = 0.92). Nevertheless, no significant differences were recognized when Mining + Plant was compared to Engineering + Technical services (M = 2.55, SD = 1.12) regarding indirect cost of unsafe environment. The results here are rather unusual. One would expect a higher mean score for Administration staff (which includes finance) than for the employees in the mining + plant departments due to different levels of understanding when it comes to costs. One would expect the administrative staff to fully understand the cost implications of unsafe work environment as they are responsible for the calculation of costs after accidents and also involved with things like resource allocation. This could be because the employees in the mining + plant departments are exposed to information in relation to accidents and costs associated with accident and therefore understand the cost implications of accidents to the Colliery.

E Factor 3 (*<u>Work environment in relation to safety</u>*): According to the results reflected in *Table 4.14* about the work environment, significant differences were noted between Administration (M = 4.26, SD = 0.55) and Engineering + Technical services (M = 3.85, SD = 0.62) as well as between Administration and Mining + Plant (M = 4.00, SD = 0.65). The plausible reason for these differences could be that the employees in the administration department work in offices and are not exposed to the same safety risks and hazards as the employees in the Mining + Plant department. This is in relation to the equipment that is used in the mine and the hostile mining environment. Differences were also found between Mining + Plant and Engineering + Technical services. Although engineering and technical staff are located in the mine and are responsible for repairing and servicing the equipment used in the mine and shares the same environment, their exposure to hazards is not the same. Their work is not as dangerous as mining. For example; the huge equipment that miners operate especially during the night shifts on slippery routes during rainy seasons, old under-mined areas, exposure to dust and explosives, noise due to blasting activities that are carried out at the mine.

Further comparisons were carried out on gender, designation, English proficiency, academic qualification and years of experience to determine if there were any differences in the participants' responses. The means for years of experience were compared and the results for these comparisons are reported in *Table 4.15* and discussed below.

4.4.4.2. Differences identified between years of experience

In the questionnaire there are seven intervals indicating the participants' years of experience (Question A4). However, these intervals were regrouped for comparison purposes into three intervals. Otherwise there would be very few participants in each group.

Table 4.15: Mean comparisons for years of experience in homogeneous subsets

		B Total	**C Total**	**D Total**	**BF1**	**BF2**	**CF1**	**CF2**
Years of experience	**N**	**Subset 1**	**Subset 1**	**Subset 1**	**Subset 1**	**Subset 1**	**Subset 1**	**Subset 1**
0 - 10 years	68	4.17	2.69	2.50	4.26	3.92	2.32	3.25
11 - 20 years	42	4.08	2.70	2.40	4.17	3.83	2.38	3.17
21 - >26 years	30	4.28	2.50	2.33	4.46	3.77	2.11	3.09

Table 4.15. Continues

		DF	EF3	EF4
Years of experience	**N**	**Subset 1**	**Subset 1**	**Subset 1**
0 - 10 years	68	2.24	3.40	3.94
11 - 20 years	42	2.16	4.11	3.79
21 - >26 years	30	2.03	4.14	3.86

Table 4.15. Continues

		E Total		EF1				EF2	
Years of experience	**N**	**Subset 1**	**Subset 2**	**Subset 1**	**Subset 2**	**Years of experience**	**N**	**Subset 1**	**Subset 2**
21 - >26 years	30	3.18		3.16		21 - >26 years	30	2.23	
0 - 10 years	68		3.47	3.52	3.52	11 – 20 years	42		2.70
11 - 20 years	42		3.48		3.67	0 – 10 years	68		2.83

E Total shows similarities between 0 - 10 years and 11 - 20 years yet these two groups are different from 21 - >26 years. EF1 shows the variance between 21 - >26 years and 11 - 20 years while EF2 shows similarities between 0 - 10 years and 11 - 20 years and the difference is acknowledged between 21 - >26 years and 11 - 20 years as well as between 21 - >26 years and 0 – 10 years. While the rest do not show any differences and fall in the same homogenous subset.

Table 4.16: Mean differences as revealed by ANOVA based on the years of experience

Safety control measures and production cost = [F(2,137) = 3.369, p = 0.037]		**Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**
E Total	Between groups Within groups	2.02 40.98	2 137	1.01 0.30	3.37	*0.04
Total		**43.00**	**139**			
Perceptions in relation to indirect cost of work accidents and injuries [F(2,137) = 3.981, p = 0.027]						
E Factor 1	Between groups Within groups	4.64 79.81	2 137	2.32 0.58	3.98	*0.03
Total		**84.45**	**139**			
Perceptions in relation to direct cost of unsafe environment [F2,137) = 3.426, p = 0.035]						
B Factor 1	Between groups Within groups	7.51 150.13	2 137	3.75 1.10	3.43	*0.04
Total		**157.64**	**139**			

* Significant at the 0.05 level.

Table 4.17: Post-hoc results using the Turkey HSD test

Dependent variable	Years of experience		Mean differences	Std. error	Sig.
E Total	0 – 10 years	11 – 20 years	-0.01	0.11	0.99
		21 – >26 years	0.29	0.12	*0.00
E Factor 1	11 – 20 years	0 – 10 years	0.15	0.15	0.56
		21 – >26 years	0.51	0.18	*0.02
E Factor 2	0 – 10 years	11 – 20 years	0.13	0.21	0.80
		21 – >26 years	0.60	0.23	*0.03

* The mean significance at 0.05 level.

E Total *(<u>Safety controls and production cost</u>):* The score for the respondents with 0 - 10 years of experience (M = 3.47, SD = 0.61) did not differ significantly when compared to the respondents with 11 - 20 years of experience (M = 3.48, SD = 0.51). But a significant difference was noted on safety control measures and production cost between 0 - 10 years and 21 - >26 years of experience (M = 3.18, SD = 0.44). According to Kecojevic, Komlijenovic, Groves & Radomsky (2007:453-454) experienced workers are aware and understand the physical hazards, the extent and range of those hazards and the cost implications thereof. This is why the jobs that require greater skill and responsibility are entrusted to experienced workers as they can avoid accident occurrences and accumulation of costs associated with accidents (Paul & Maiti 2007:453-454). However in the case of the Colliery in question, the results indicate a high score for the employees with 0 – 10 years – M = 3.47. This implies that there are less chances for inexperienced workers to be involved in an accident than the experienced miners. One possible conclusion could be that this is caused by the fact that inexperienced workers are still afraid of making mistakes therefore, they are more careful; they follow the rules to avoid mistakes, suspension or dismissal at the beginning of their careers.

E Factor 1 *(<u>Perceptions of indirect cost of work accidents and injuries</u>):* The results did not show a significant difference between 11 - 20 years (M = 3.67, SD = 0.63) and 0 - 10 years (M = 3.52, SD = 0.78). Nevertheless, significant differences were recognized when 11 - 20 years were compared to 21 - >26 years (M = 3.16, SD = 0.88) on perceptions in relation to indirect cost of work accidents and injuries. It is often believed that retraining, passage of time and regular cost reports presented at the safety meetings equip old workers with experience and thus make them aware of safety requirements (Choudhy & Fang 2008:576). This is because training emphasizes safe work practices that prevent workplace accidents (Lanoie & Trotter 1998:65). Conversely, experienced employees at the Colliery have the lowest score in relation to indirect cost of work accidents and injuries. It can be concluded that experienced employees have been exposed to incidents and accidents for more time in their lives and are not worried anymore about the hazardous working environment. This could encourage employees to get involved in unsafe acts which result in the accumulation of indirect costs for the organisation.

E Factor 2 ***(<u>Perceptions in relation to direct cost of unsafe environment</u>):*** According to the results reflected in *Table 4.17*, there were no significant differences identified regarding perceptions in relation to direct costs of unsafe environment between 0 -10 years (M = 2.83, SD = 1.14) and 11 - 20 years (M = 2.70, SD = 1.05) but significant differences were established when 0 - 10 years was compared to 21 - >26 years of experience (M = 2.23, SD = 0.78). As espoused by Choudhry and Fang (2008:575-576) experienced workers at times feel uncomfortable following safety procedures and perform risky jobs due to encouragement from co-workers in order to demonstrate self-esteem. They also avoid the use of PPE so that they may not be teased by other employees. Unfortunately, during the exhibition of self-esteem they get involved in accidents which results in the accumulation of costs for the organisation.

4.4.4.3. Differences between means for designation groups

The designation identifies the position held by the respondents at the Colliery. In the questionnaire (Question A3), there were nine designation divisions which comprised top management (1), pit superintendent (2), assistant pit superintendent (3), safety officer (4), foremen (5) and supervisors (6). Collectively, the aforementioned were classified as Management as they all guarantee the safety of the mine through resource allocation, identification of risks, provide assurance that safety measures are in place to control risks and enforce the application as well as the implementation of safety measures as highlighted in 4.4.1.1. Safety representatives, operators and others were classified as Employees. The intention here was to establish the differences between the perceptions of general employees and management in relation to safety. Based on the fact that only two groups were used for comparison; t-test was found suitable. The homogeneity of variance assumption was applied in the study (Field 2009:324-326). This assumption states that if the significance of variance is less than 0.05 (<.05), the homogeneity of variance is not met (indicated with an asterisk star * in the table) but it is met if the significance of variance is greater than 0.05 (>0.05). Where the assumption was not met, the second row of data associated with the 'Equal variances not assumed' was used to determine the variances between group means. The results are highlighted in *Table 4.18* which exhibits that there were no statistically significant differences identified between the perceptions of management and general employees in relation to safety within the Colliery. This is made apparent by the fact that all the P-values were >0.05.

Table 4.18: Equality of Variance and Means for designation

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	P-value/ Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
B Total	Equal variances assumed	0.00	1.00	0.82	145	0.41	0.07	0.09
	Equal variances not assumed			0.84	123.24	0.40	0.07	0.09
C Total	Equal variances assumed	2.21	0.14	0.15	145	0.88	0.02	0.12
	Equal variances not assumed			0.16	126.29	0.88	0.02	0.12
D Total	Equal variances assumed	2.60	0.11	-0.72	145	0.47	-0.09	0.13
	Equal variances not assumed			-0.74	124.01	0.46	-0.09	0.12
E Total	Equal variances assumed	0.10	0.75	0.73	145	0.47	0.07	0.09
	Equal variances not assumed			0.72	109.48	0.47	0.07	0.09

BF1	Equal variances assumed	0.30	0.58	0.40	145	0.69	0.04	0.10
	Equal variances not assumed			0.40	113.91	0.69	0.04	0.10
BF2	Equal variances assumed	5.43	*0.02	1.41	145	0.16	0.17	0.12
	Equal variances not assumed			1.52	139.33	0.130	0.17	0.11
CF1	Equal variances assumed	3.90	*0.05	0.15	145	0.883	0.02	0.15
	Equal variances not assumed			0.15	128.74	0.88	0.02	0.14
CF2	Equal variances assumed	0.60	0.44	0.10	145	0.924	0.012	0.12
	Equal variances not assumed			0.10	120.49	0.923	0.012	0.12
DF	Equal variances assumed	1.59	0.21	-0.88	145	0.381	-0.14	0.15
	Equal variances not assumed			-0.90	121.28	0.37	-0.14	0.15
EF1	Equal variances assumed	5.23	*0.02	1.13	145	0.26	0.15	0.13
	Equal variances not assumed			1.22	139.79	0.22	0.15	0.12
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	P-value/ Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
EF2	Equal variances assumed	1.225	0.27	1.09	145	0.28	0.20	0.18
	Equal variances not assumed			1.06	105.72	0.29	0.20	0.19
EF3	Equal variances assumed	0.08	0.78	-0.92	145	0.36	-0.10	0.11
	Equal variances not assumed			-0.94	121.85	0.35	-0.10	0.10
EF4	Equal variances assumed	0.06	0.81	-1.17	145	0.25	-0.15	0.13
	Equal variances not assumed			-1.18	118.43	0.24	-0.15	0.13

4.4.4.4. Differences between means for English proficiency

The group means for English proficiency of the respondents were also compared to determine if there were any differences that could be identified. These means were compared in homogenous subsets (*Table 4.19)* before ANOVA was computed. The results for this comparison are shown in *Table 4.20.*

Table 4.19: Comparison of group means for English Proficiency

GROUP	N	C TOTAL	BF2	CF2	EF1	EF3
Poor + Fair	39	2.72	3.86	3.01	3.29	3.93
Good	76	2.72	3.86	3.24	3.33	3.94
Excellent	36	2.50	3.93	3.31	3.64	4.18

Table 4.19. Continues

GROUP	N	B Total		D Total		CF1		DF	
		Subset		Subset		Subset		Subset	
		1	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Poor + Fair	39	4.05		2.71		253		2.55	
Good	76	4.12		2.40	2.40	2.37	2.37	2.14	2.14
Excellent	36		4.41		2.19		1.96		1.83

Table 4.19. Continues

GROUP	N	E Total		EF2		GROUP	N	BF1		EF4	
		Subset		Subset				Subset		Subset	
		1	**2**	**1**	**2**			**1**	**2**	**1**	**2**
Excellent	36	3.18		2.06		**Poor + Fair**	39	4.11		3.62	
Poor + Fair	39	3.33	3.33		2.82	**Good**	76	4.21		3.86	3.86
Good	76		3.55		2.85	**Excellent**	36		4.574		4.06

Table 4.20: Mean differences as revealed by ANOVA based on English proficiency

Adherence to safety legislation = [F(2,15) = 5.46, p = 0.01]		**Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**
B Total	Between groups	2.90	2	1.45	5.46	*0.01
	Within groups	39.24	148	0.27		
Total		**42.14**	**150**			

Employees' perceptions and attitude towards safety controls [F(2,15) = 4.97, p = 0.01]					
D Total Between groups	5.16	2	2.58	4.97	*0.01
Within groups	76.80	148	0.52		
Total	**81.96**	**150**			
Safety control measures and production cost [F2,15) = 6.23, p = 0.00]					
E Total Between groups	3.63	2	1.81	6.23	*0.00
Within groups	43.12	148	0.29		
Total	**46.75**	**150**			
Compliance to safety legislation = [F(2,15) = 7.47, p = 0.00]					
B Factor 1 Between groups	4.68	2	2.34	7.47	*0.00
Within groups	46.34	148	0.31		
Total	**51.02**	**150**			
Employees' compliance and commitment to safety = [F(2,15) = 4.46, p = 0.01]					
C Factor 1 Between groups	6.71	2	3.35	4.46	*0.01
Within groups	111.25	148	0.75		
Total	**117.95**	**150**			
Employees' perceptions on safety culture = [F(2,15) = 6.53, p = 0.00]					
D Factor Between groups	9.87	2	4.93	6.53	*0.00
Within groups	111.77	148	0.76		
Total	**121.63**	**150**			
Perceptions on indirect cost of work accidents = [F(2,15) = 3.71, p = 0.03]					
E Factor 1 Between groups	4.34	2	2.17	3.71	*0.03
Within groups	86.58	148	0.59		
Total	**90.92**	**150**			
Perceptions in relation to direct cost of work injuries = [F(2,15) = 8.20, p = 0.00]	**Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**
E Factor 2 Between groups	16.99	2	8.49	8.20	*0.00
Within groups	153.24	148	1.04		
Total	**170.23**	**150**			
Perceptions on cost reduction due to adherence to safety measures and procedures = [F(2,15) = 2.92, p = 0.06					
E Factor 4 Between groups	3.52	2	1.76	2.92	0.06
Within groups	89.10	148	0.60		
Total	**92.62**	**150**			

* Significant at the 0.05 level.

E Factor 4 (*<u>Perceptions on cost reduction due to adherence to safety measures and procedures</u>*): According to the results in the table above; ANOVA does not reflect a significant difference (0.06) between groups. This is because the significance for this factor is above 0.05. However; after computing post-hoc test; the results indicate that there were differences identified between the respondents with Excellent and Poor + Fair English proficiency. The results are reported in the *Table 4.21* below.

Table 4.21: Post-hoc results using the Turkey HSD test

Dependent variable	Years of experience		Mean differences	Std. error	Sig.
B Total	Excellent	Poor + Fair	0.37	0.12	*0.01
		Good	0.29	0.10	*0.02
D Total	Excellent	Poor + Fair	-0.52	0.17	*0.01
		Good	-0.21	0.15	0.33
E Total	Excellent	Poor + Fair	-0.15	0.12	0.46
		Good	-0.37	0.11	*0.00
B Factor 1	Excellent	Poor + Fair	0.47	0.13	*0.00
		Good	0.37	0.11	*0.00
C Factor 1	Excellent	Poor + Fair	-0.58	0.20	*0.01
		Good	-0.41	0.18	0.05
D Factor	Poor + Fair	Good	0.41	0.17	*0.05
		Excellent	0.72	0.20	*0.00
E Factor 1	Excellent	Poor + Fair	0.36	0.15	*0.05
		Good	0.32	0.15	0.10
E Factor 2	Excellent	Poor + Fair	-0.76	0.24	*0.00
		Good	-0.80	0.21	*0.00
E Factor 4	Excellent	Poor + Fair	0.40	0.18	*0.05
		Good	0.20	0.16	0.42

* The mean significance at 0.05 level.

B Total (*<u>Adherence or compliance to safety legislation</u>*): Differences were specified between Excellent (M = 4.42, SD = 0.07) and Poor + Fair (M = 4.04, SD = 0.52) as well as Good (M = 4.12, SD = 0.56) regarding adherence of the Colliery with safety legislation. This could be due to communication errors and misunderstanding of safety policies, procedures and measures.

D Total (*<u>Employees' perceptions and attitude towards safety controls</u>*): The differences between Excellent (M = 2.19, SD = 0.52) and Poor + Fair (M = 2.71, SD = 0.82) could be because of inability for the respondents with limited English language proficiency to take responsibility of their own safety due to lack of understanding of the information provided. As a result; this language barrier can affect one's perceptions and attitude towards safety.

E Total *(Safety controls and production cost):* The variances were established between Excellent English proficiency (M = 3.18, SD = 0.52) and Good English proficiency (M = 3.55, SD = 0.58). A credible reason could be that the employees with Excellent English proficiency are not paying attention to safety measures and not because of lack of understanding of the safety measures. This is because Stevens (2010:108) argued that it is only the employees with limited English proficiency who may lack understanding of safety measures. This may result in increased occupational health and safety problems and low productivity which affect the cost of production.

B Factor 1 *(Compliance with safety legislation):* The cause of the difference in relation to the Colliery's safety compliance found when Excellent English proficiency (M = 4.57, SD = 0.08) was compared to Good (M = 4.21, SD =0.07) and Poor + Fair (M = 4.11, SD = 0.09). These differences could be because it is difficult to comply with the measures that do not make sense. The respondents can never be sure whether they are or the organisation itself is compliant as they are always not sure whether what they do to ensure their own safety is really what is expected of them or the organisation is doing what it is expected to do according to the requirements of the law.

C Factor 1 *(Employees' compliance and commitment to safety):* The differences were identified safety between Excellent (M = 1.96 SD = 0.7) and Poor + Fair English proficiency (M = 2.53, SD = 0.89). A probable reason being that it is almost impossible to comply and commit to something that one does not understand and this can lead to lack of confidence.

D Factor *(Employees' perceptions on safety culture):* Differences with regard to safety culture were established when Excellent (M = 1.83, SD = 0.64) was compared with Good (M = 2.14, SD = 0.92) and Poor + Fair (M = 2.55, SD = 0.96). Dimirkesen and Arditi (2015:2) believe that knowledge, orientation and skills development with regard to safety are transferred through training, presentations and communication which may also result in improved safety culture. However, safety training, presentations and communication are conducted in the English language.

Due to language barriers, there could be misunderstanding, dissatisfaction and lack of trust in the quality of safety.

E Factor 1 ***(Perceptions on indirect cost of unsafe environment):*** Differences were identified between Excellent (M = 3.64, SD = 0.77) and Poor + Fair (M = 3.29, SD = 0.86). A conceivable reason for this variance could be limited English proficiency that leads to poorly trained employees due to failure to understand the presentations. This may result in employees who get involved in unsafe acts or behaviours which result in the accumulation of costs.

E Factor 2 ***(Perceptions on direct cost in relation to work accidents):*** Excellent (M = 2.06, SD = 0.75) differed significantly from Good (M = 2.85, SD = 1.14) and Poor + Fair (M = 2.82, SD = 0.96). Trajkovski and Loosemore (2006: 450-451) are of the view that the employees with limited English proficiency fail to understand rules and instructions which may lead to accidents as the employees do not know what they are expected to do or what the rules and procedures instruct them to do. In the case of the Colliery under study, the employees with Good and Poor + Fair English proficiency have the higher mean. A plausible reason could be that safety control mechanisms and training are provided in a variety of languages. Moreover, there are demonstrations regarding the application of procedures, translation of safety rules and procedures, equipment manuals, hazardous materials user instructions and other printed materials related to safety. Furthermore, the mine under study could be making use of images instead of words within the organisation to ensure that the information provided is understood by all employees.

E Factor 4 ***(Perceptions on cost reduction due to adherence to safety measures and procedures):*** variances were found between Excellent (M = 4.06, SD = 0.69) and Poor + Fair English proficiency (M = 3.86, SD = 0.82). The likely reason for this difference could be that English Language proficiency is associated with fewer accidents due to reduced errors as they understand the rules and procedures, ability to report problems discovered during the performance of duties or during the application of rules, ability to make suggestions in relation to rules that are impossible to apply and the ability to relate to other employees. This ability to understand the controls and procedures can result in enhanced employee confidence and improved morale as they know and understand exactly what they are supposed to do to ensure their own safety and to maintain a safe workplace.

This confidence and improved morale can result in better safety performance, argued Mikulecky (2011:211).

4.4.4.5. Differences between means for gender

One-way ANOVA was employed in this study to establish differences between three groups. For gender there are only two groups; male and female therefore t-test was applied to determine the differences between these groups. Refer to Question A1 in the questionnaire.

Table 4.22: Group statistics for gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean
B Total	Male	90	4.14	0.59	0.06
	Female	59	4.22	0.42	0.05
C Total	Male	90	2.70	0.69	0.07
	Female	59	2.61	0.71	0.09
D Total	Male	90	2.41	0.72	0.08
	Female	59	2.46	0.76	0.10
E Total	Male	90	3.42	0.57	0.06
	Female	59	3.39	0.55	0.07
BF1	Male	90	4.22	0.65	0.07
	Female	59	4.34	0.47	0.06
BF2	Male	90	3.89	0.74	0.08
	Female	59	3.86	0.72	0.09
CF1	Male	90	2.35	0.90	0.10
	Female	59	2.25	0.87	0.11
CF2	Male	90	3.23	0.69	0.07
	Female	59	3.14	0.77	0.10
DF	Male	90	2.14	0.88	0.09
	Female	59	2.21	0.93	0.12
EF1	Male	90	3.54	0.77	0.08
	Female	59	3.40	0.78	0.10
EF2	Male	90	2.64	1.06	0.11
	Female	59	2.69	1.10	0.14
	Gender	N	Mean	Std. Deviation	Std. Error Mean

EF3	Male	90	4.08	0.65	0.07
	Female	59	4.03	0.58	0.08
EF4	Male	90	3.83	0.84	0.09
	Female	59	3.92	0.67	0.09

Table 4.23:Equality of Variance and Means for Gender

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	P-value/ Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
B Total	Equal variances assumed	4.37	*0.04	-0.96	147	0.34	-.085	0.09
	Equal variances not assumed			-1.03	146.16	0.30	-.085	0.08
C Total	Equal variances assumed	0.01	0.93	0.80	147	0.42	0.09	0.12
	Equal variances not assumed			0.80	122.49	0.43	0.09	0.12
D Total	Equal variances assumed	0.06	0.81	-0.37	147	0.71	-0.05	0.12
	Equal variances not assumed			-0.36	119.33	0.72	-0.05	0.13
E Total	Equal variances assumed	0.17	0.68	0.30	147	0.76	0.03	0.09
	Equal variances not assumed			0.31	127.10	0.76	0.03	0.09
BF1	Equal variances assumed	4.70	*0.03	-1.25	147	0.21	-0.12	0.10
	Equal variances not assumed			-1.34	145.31	0.18	-0.12	0.09
BF2	Equal variances assumed	0.17	0.69	0.22	147	0.83	0.03	0.12
	Equal variances not assumed			0.22	126.98	0.83	0.03	0.12
CF1	Equal variances assumed	0.31	0.58	0.68	147	0.50	0.10	0.15
	Equal variances not assumed			0.68	126.56	0.50	0.10	0.15
CF2	Equal variances assumed	0.54	0.47	0.69	147	0.49	0.08	0.12

	Equal variances not assumed			0.68	114.15	0.50	0.08	0.12
		Levene's Test for Equality of Variances		t-test for Equality of Means				
DF	Equal variances assumed	F	P-value/ Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
	Equal variances not assumed			-0.45	119.41	0.66	-0.07	0.15
EF1	Equal variances assumed	0.00	0.95	1.07	147	0.29	0.14	0.13
	Equal variances not assumed			1.06	122.40	0.29	0.14	0.13
EF2	Equal variances assumed	0.03	0.86	-0.30	147	0.77	-0.05	0.18
	Equal variances not assumed			-0.29	120.70	0.77	-0.05	0.18
EF3	Equal variances assumed	3.18	0.08	0.42	147	0.68	0.04	0.11
	Equal variances not assumed			0.43	134.39	0.67	0.04	0.10
EF4	Equal variances assumed	7.12	0.01	-0.66	147	0.51	-0.09	0.13
	Equal variances not assumed			-0.69	140.74	0.49	-0.09	0.12

The table above highlights the results of comparison between male and female respondents at the Colliery. These results show that there were no statistically significant differences identified between these two groups as all the P-values were above 0.05.

4.4.4.6. Differences between means for qualification

The questionnaire has five categories but they were regrouped into two due to the small number of participants in certain categories. Therefore t-test was employed to establish differences between these groups.

Table 4.24: Group Statistics for Qualification

	Qualification	N	Mean	Std. Deviation	Std. Error Mean
B Total	No Tertiary qualification	54	4.19	0.54	0.07
	Tertiary qualification	95	4.17	0.52	0.05
C Total	No Tertiary qualification	54	2.66	0.62	0.08
	Tertiary qualification	95	2.68	0.73	0.08
D Total	No Tertiary qualification	54	2.41	0.71	0.10
	Tertiary qualification	95	2.45	0.76	0.08
E Total	No Tertiary qualification	54	3.21	0.48	0.07
	Tertiary qualification	95	3.51	0.57	0.06
BF1	No Tertiary qualification	54	4.30	0.56	0.08
	Tertiary qualification	95	4.26	0.59	0.06
BF2	No Tertiary qualification	54	3.85	0.81	0.11
	Tertiary qualification	95	3.90	0.69	0.07
CF1	No Tertiary qualification	54	2.35	0.83	0.11
	Tertiary qualification	95	2.30	0.93	0.10
CF2	No Tertiary qualification	54	3.13	0.65	0.09
	Tertiary qualification	95	3.25	0.74	0.08
DF	No Tertiary qualification	54	2.17	0.89	0.12
	Tertiary qualification	95	2.17	0.92	0.09
EF1	No Tertiary qualification	54	3.15	0.90	0.12
	Tertiary qualification	95	3.66	0.64	0.07
EF2	No Tertiary qualification	54	2.42	.89	0.12
	Tertiary qualification	95	2.78	1.12	0.12
EF3	No Tertiary qualification	54	4.13	0.67	0.09
	Tertiary qualification	95	4.03	0.61	0.06
EF4	No Tertiary qualification	54	3.75	0.83	0.11
	Tertiary qualification	95	3.91	0.76	0.08

Table 4.25: Equality of Variance and Means for qualification

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	P-value/ Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
B Total	Equal variances assumed	1.20	0.27	0.26	147	0.80	0.02	0.09
	Equal variances not assumed			0.25	106.69	0.80	0.02	0.09
C Total	Equal variances assumed	0.88	0.35	-0.15	147	0.88	-.02	0.12
	Equal variances not assumed			-0.16	126.03	0.87	-.02	0.11
D Total	Equal variances assumed	0.00	1.00	-0.33	147	0.74	-0.04	0.13
	Equal variances not assumed			-0.33	116.19	0.74	-0.04	0.13
E Total	Equal variances assumed	2.91	0.09	-3.17	147	*0.00	-0.29	0.09
	Equal variances not assumed			-3.34	127.17	0.00	-0.29	0.09
BF1	Equal variances assumed	0.08	0.78	0.49	147	0.63	0.05	0.10
	Equal variances not assumed			0.49	115.28	0.62	0.05	0.10
BF2	Equal variances assumed	3.43	0.07	-0.42	147	0.68	-0.05	0.13
	Equal variances not assumed			-0.40	96.50	0.69	-0.05	0.13

CF1	Equal variances assumed	0.13	0.72	0.31	147	0.76	0.05	0.15
	Equal variances not assumed			0.32	121.33	0.75	0.05	0.15
CF2	Equal variances assumed	0.48	0.49	-0.96	147	0.34	-0.12	0.12
	Equal variances not assumed			-0.99	121.91	0.32	-0.12	0.12
DF	Equal variances assumed	0.08	0.78	-0.02	147	0.98	-0.00	0.16
	Equal variances not assumed			-0.02	112.88	0.98	-0.00	0.15
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	P-value/ Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
EF1	Equal variances assumed	5.43	*0.02	-4.04	147	0.00	-0.51	0.13
	Equal variances not assumed			-3.69	84.05	*0.00	-0.51	0.14
EF2	Equal variances assumed	6.31	*0.01	-2.03	147	0.05	-0.36	0.18
	Equal variances not assumed			-2.15	131.05	*0.03	-0.36	0.17
EF3	Equal variances assumed	2.28	0.13	0.92	147	0.36	0.10	0.11
	Equal variances not assumed			0.90	101.57	0.37	0.10	0.11
EF4	Equal variances assumed	0.34	0.56	-1.18	147	0.24	-0.16	0.13
	Equal variances not assumed			-1.15	102.68	0.25	-0.16	0.14

* The mean significance at 0.05 level.

E Total *(<u>Safety controls and production cost</u>)*: The score for the respondents Without Tertiary Qualification of (M = 3.21, SD = 0.48) differed significantly when compared to the respondents With Tertiary Qualification (M = 3.51, SD = 0.57); t = (147) = -3.17, P = 0.00. A possible reason could be due to the positive mind set and attitude as well as understanding of the rules and the consequences of not following the safety rules normally possessed by employees with qualifications.

E Factor 1*(<u>Perceptions of indirect cost of work accidents</u>):* The results showed a significant difference between the respondents with No Tertiary Qualification (M = 3.15, SD = 0.90) and those with Tertiary Qualification (M = 3.66, SD = 0.64); t = (147) = -3.67, P = 0.00. A probable reason could be that it is easy for the employees with qualifications to understand the safety rules and procedures. It is easy for the employees with qualifications as well to understand the practices, hazards and the consequences of accidents better than those with lower or without qualifications (Vinodkumar & Bhasi 2009:666).

E Factor 2 *(<u>Perceptions in relation to direct costs of unsafe environment</u>):* There were significant differences identified between the participants With Tertiary Qualification (M = 2.42, SD = 0.89) and those Without Tertiary Qualification (M = 2.78, SD = 1.12); t = (147) = -2.15, P = 0.03. It could be because of the failure to understand the rules and procedures and hazards associated with different tasks, failure to apply proper procedures, taking risks and shortcuts and failing to understand the cost implications of these acts due to lower qualifications.

The results above indicate the analysis of safety control mechanisms and production cost based on the perceptions of the employees in relation to the nine factors identified in 4.4.3. Different perceptions were also highlighted based on designation, years of experience, qualification, English proficiency and department. Therefore; the sixth empirical objective has been achieved.

4.5. SYNOPSIS

The attention in this chapter was placed on the empirical results of the study in relation to the validity and reliability of the questionnaire. A detailed discussion on the results obtained through descriptive analysis, factor analysis and ANOVA were provided in this chapter. The final overview of the study is provided in Chapter 5 in order to establish whether the objectives of the study were achieved or not. This final chapter provides the limitations, implications for future research, recommendations and conclusions derived from the study.

CHAPTER 5

CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

5.1. INTRODUCTION

The main focus of the previous chapter was to provide detailed reporting of results and analysis of empirical findings which are contained in the tables and figures utilised in the presentation of the results. The purpose of this chapter therefore; is to provide an evaluation of findings based on the results reported in the previous chapter in relation to the objectives of this study. The chapter also encompasses the recommendations based on the findings, limitations and implications for further research.

The study was conducted scientifically that is; it followed a systematic process whereby the problem was established, both theoretical and empirical objectives were determined and the study was founded and guided by four theories. Moreover, the statistical methods for data analysis were highlighted and discussed and based on the findings the study made recommendations and the conclusion was formulated.

5.2. OBJECTIVES OF THE STUDY

5.2.1. Primary objective

This was to investigate whether or not the mine (colliery) in question adheres to the legislative requirements and has safety controls in place to ensure the safety of employees and to examine the production cost in relation to safety control mechanisms at the Colliery. This objective was achieved in sections 4.4.1.2, 4.4.1.3, 4.4.1.4, 4.4.1.5, 4.4.3 and 4.4.4. In order to reach the primary objective the following empirical and theoretical objectives were formulated for the study.

5.2.2. Empirical objectives

5.2.2.1. To establish whether or not the mine conforms to the relevant legislation regarding safety controls

The first empirical objective was achieved in section 4.4.1.2. The frequency tables in this section highlighted and established the conformity of the Colliery with the legislation. A high number of employees regard their organisation to be up-to-date with the legislation as it has the safety policy, safety measures and procedures in place to ensure safety and guide performance of duties. According to the employees; the employee safety representatives are involved in ensuring safety, the information regarding the hazards associated with their jobs as well as the personal protective equipment (PPE) are provided as mandated by the *Mine Health and Safety Act No. 29 of 1996* (RSA 1996:13-24). Yapp and Fairman (2006:50) are certain that the organisation that abides by the legislation understands the legislation better, it gains knowledge regarding the issues related to legislation, confidence when dealing with safety legislation, and understanding and trust in the legislation.

5.2.2.2. To determine whether or not the employees abide by the rules and apply safety control procedures

Safety compliance refers to willingness to abide by and obey the safety rules. It relates to the activities that are carried out within the organisation by the employees to ensure their own safety and the safety of others while at work in order to maintain the workplace safety through the application of rules and procedures (Jiang, Yu, Li & Li 2010:1469-1470). This is the second empirical objective which was recognized in section 4.4.1.3 where a large number of employees specified that they do not deviate from safety rules and procedures. Employees also indicated that the rules and procedures are readily available and understandable although some of them are impossible to apply. Employees showed understanding that the safety rules should never be ignored although there are too many rules for one to remember.

5.2.2.3. To establish the attitude and perceptions of employees with regard to safety control procedures

Jiang *et al.* (2010:1471) are of the opinion that attitudes and perceptions determine the behaviour of employees. The authors maintain that the colleagues with safety knowledge and who behave safely, act as a guide for other employees. This is because if employees believe that their colleagues have knowledge and understanding of safety rules and procedures and are believed to be working safely, other employees would behave in the same manner. Clarke (2006:414) argues that attitudes of employees towards safety reflect the 'safety culture' of the organisation which is often used interchangeably with the expression 'safety climate'. A positive safety climate results in fewer accidents in hazardous industries. Hence, the workforce with a positive safety attitude is less likely to be involved in accidents (Cheyne, Oliver, Tomas & Cox 2002:651). The attitude of employees at the Colliery towards safety controls was determined in section 4.4.1.4. As a result the third empirical objective was accomplished. The majority of employees in this section were in disagreement that acting with common sense is safer than following the rules, that rules remove skills, make tasks complicated and therefore should be broken to get the job done. Employees also made known that they understand why rules should be followed at all times. Hence, this is an indication of a positive safety culture.

5.2.2.4. To conduct an analysis of safety control mechanisms and production cost at the mine

This objective was achieved in section 4.4.1.5. The safety controls and costs within the organisation were examined to establish whether or not the employees are aware of the importance and the need of having safety control measures within the organisation to enable them to determine the consequences of accidents in relation to cost implications of accidents in the organisation. It also revealed what the organisation has been able to achieve in relation to the reduction of costs due to the application and implementation of safety measures based on the perceptions of the employees.

5.2.2.5. To identify sensible focus points to manage safety control procedures

This objective was achieved in section 4.4.3 where nine managerial focus points with regard to safety control mechanisms and production cost were identified by means of Exploratory Factor Analysis. 56 items in the questionnaire were reduced to 49 retained items grouped into factors which may enable management to manage the indicated nine focus points/factors, instead of all 56 items in the questionnaire, to improve safety mechanisms and simultaneously get rewarded by lowering production costs. Furthermore, the intensity and urgency of managing the nine indicated factors should be differently applied between departments.

5.2.2.6. To determine the differences between groups in relation to safety using One-way ANOVA and t-test

Different perceptions were identified when Mining and Plant departments were compared to Engineering and Technical services as well as the Administration department. Many differences were found when the responses of Mining and Plant departments were compared to the responses of the participants in the Engineering and Technical services and Administration department on the nine factors identified and retained namely: *Compliance of the Colliery to safety legislation, Supportive environment, Perceptions on cost reduction due to adherence to safety measures and procedures, Management commitment to safety, Employees' compliance and commitment to safety, Employees' perceptions on safety culture, Perceptions of Indirect cost of work accidents and injuries, Perceptions in relation to direct cost of unsafe work environment and Work environment in relation to safety*. Moreover, differences were established when comparisons were made in relation to years of experience at the Colliery, designation, qualifications, home language and English proficiency based on the factors identified above and explained in detail in Chapter 4. This objective was achieved in section 4.4.4.

5.2.3. Theoretical objectives

5.2.3.1. To conduct a literature review on legislation governing safety controls in the mining industry in South Africa and Canada

This objective was addressed and met in section 2.4 under the legislative framework in South Africa. The apartheid laws and the current legislation were taken into consideration. From the literature; it was evident how the mine workers used to be oppressed and that their safety was not an important aspect of the apartheid laws. The mine workers did not have the right to complain or to strike if they had concerns about their safety and positions were occupied based on the skin colour and not on qualifications. However; *Mine Health and Safety Act No. 29 of 1996* gave the mine workers' rights especially in relation to their safety. Among these rights, miners are given the right to refuse dangerous work and the right to leave dangerous working places (RSA 1996:28).

5.2.3.2. Literature review on mine injuries and deaths due to lack of safety in South Africa, USA, Australia and Canada

Under section 2.5, mine injuries and deaths in South Africa were revealed. Based on the contents of this section, it is apparent that there are many miners who still get injured and die in South African mines. To establish whether it is possible for the country to prevent injuries and fatalities;

South Africa was compared to its counterparts in the mining industry - Canada, Australia and USA. The comparison revealed a reduction in the number of fatalities and injuries in these countries but South Africa's results were unacceptably high. In 2012 and 2013 the country had 112 and 93 fatalities, 3 377 and 3 126 injuries respectively (Department of Mineral Resources 2014:30).Yet Australia only reported 17 in 2013 and zero fatalities in 2012; an obvious success for their industry philosophy of Zero harm (Hagemann 2014). South Africa adopted this philosophy in 2003 to achieve zero fatalities and injuries by 2013. Unfortunately the country failed to achieve this target, it is not even close to the target (as it had 93 fatalities in the same year) like its competitors – USA, Canada and Australia (Biyase 2013).

5.2.3.3. Literature review on Normal Accident Theory (NAT) and High Reliability Theory (HRT)

The two theories are contained in section 2.2.1 and 2.2.2 respectively. These theories contradict with each other based on the fact that NAT believes that accidents are inevitable regardless of whether there are safety measures and controls in place or not (Hovden, Albrechsten & Herrera 2010:953). Naveh and Marcus (2007:732) maintain that because accidents occur regularly and on a continuous basis they are therefore considered to be normal. But HRT believes that if organisations put measures and controls in place, eliminate all points of exposure and vulnerability; all accidents can be prevented even if unexpected events are experienced (Hovden *et al.* 2010:953).

5.2.3.4. Literature review on Safety Control Cost Theory and Indirect Cost Theory of Accident Prevention

The literature under section 2.2.3 provides evidence that the investments towards safety and the implementation of safety measures determine the level of safety within the organisation. As a result, the higher the investment, the higher the level of safety and therefore the lower the costs (Son *et al.* 2000:188). Valls, Lozano, Yanez, Pascual. Lloret and Ruiz (2007:1355) indicated that the investment in the safety facilities and measures result in the decrease in the number of fatalities and injuries as well as the costs associated with them. This study revealed that there were fourteen (14) injuries before implementation and only one (1) after implementation. It is evident under section 2.2.4 that for every accident that occurs within an organisation, there are indirect or hidden costs incurred and if accidents are prevented then there will be no indirect costs incurred associated with accidents (Brody *et al.* 1990:255). Lanoie and Trottier (1998:65-66) are of the opinion that the only way to reduce indirect costs that are said to be four times the direct costs, is to put more emphasis on activities that prevent job-related accidents. This can be achieved by putting into place the prevention policies that incorporate training, providing employees with education relating to safety procedures and processes, meetings between foremen and employees, investments and provision of personal protective equipment (PPE).

5.3. LIMITATIONS OF THE STUDY AND IMPLICATIONS FOR FURTHER RESEARCH

The major limitation of the study is that the data was collected from the employees of only one colliery in the Free State, a province in South Africa. Caution is therefore necessary when attempting to generalize the results of this study to other mines which may have different dynamics from this mine. Due to production problems at the Colliery at the time of data collection and to avoid further production disruptions; the questionnaires were distributed and collected by the section heads. This was found to be a limitation because it may have posed a challenge to the participants to fully disclose their perceptions in relation to safety at the Colliery. Again, the researcher was not available at the mine when the questionnaires were filled in to assist the participants who may have encountered problems understanding and filling in the questionnaire except for the administrative staff outside the mine and plant. Furthermore, the analysis of actual costs due to safety which includes property damage, lost time, suspensions, dismissals, and accident and injury statistics, was not done. Requests were made to the Colliery to provide this information; however it was never received. Nonetheless; the study provides avenues for further research. The same study can be replicated and conducted at other collieries or mines. Furthermore, a comparative study involving a number of collieries or mines can be conducted to determine differences between mines. The result would facilitate generalisation of the findings.

5.4. SUMMARY OF FINDINGS

The findings of the study are not without implications from the theoretical point of view as they may assist organisations especially in the coal mining industry to understand the factors that motivate organisations to invest in safety. To some, safety is costly with regard to putting into place the safety measures and as a result it is considered to be burdensome. However, they fail to take into consideration the burden created by the costs incurred due to accident occurrences that are normally regarded as the cost of running the business. This is because to some extent, and consistent with NAT, an accident is an event beyond anybody's control and therefore inevitable.

Different employee perceptions were also revealed in relation to the nine dimensions retained in the current study; *Compliance of the Colliery to safety legislation, Supportive environment, Perceptions on cost reduction due to adherence to safety measures and procedures, Management commitment to safety, Employees' compliance and commitment to safety, Employees' perceptions on safety culture, Perceptions of Indirect cost of work accidents and injuries, Perceptions in relation to direct cost of unsafe work environment and Work environment in relation to safety*. Of the six comparisons performed namely *gende*r, *designation, department, years of experience, English proficiency and qualification;* English proficiency, qualification, years of experience and the department in which the employees work were found to have an influence on the perceptions of employees in relation to the above-mentioned dimensions.

Grounded on the findings, some concerns were expressed. The respondents highlighted that some rules are impossible to apply. It could be because they lack authenticity, that they are too complex, too rigid or are not flexible enough. It was also disclosed that the employees find the rules to be too numerous and about 40% (CQ10) of the respondents do not understand which rules apply to specific instances. Shifting of blame to the injured employee was also found to be a concern for the employees.

Employees in the Mining and Plant departments had different perceptions from other employees in the Engineering and Technical services as well as Administration department. Many differences were found when the responses of Mining and Plant departments were compared to those of the participants in these two departments on the nine factors identified namely: *Compliance of the Colliery to safety legislation, Supportive environment, Perceptions on cost reduction due to adherence to safety measures and procedures, Management commitment to safety, Employees' compliance and commitment to safety, Employees' perceptions on safety culture, Perceptions of*

Indirect cost of work accidents and injuries, Perceptions in relation to direct cost of unsafe work environment and Work environment in relation to safety.

Many differences were realised with regard to those with Excellent and Poor + Fair English proficiency and about 80% (BQ12) of the respondents indicated that supervisors seldom discipline the employees who break the rules. This is an indication of unsafe supervision which can lead to accidents due to failure to correct the known problem or undesirable behaviour.

5.5. CONCLUSION

Based on the results, it can be concluded that the Colliery under study disagrees with NAT hence the availability of the organisational safety policy, provision of PPE and safety control measures that are in place to ensure safety and prevent accidents. It is also evident that the Colliery is in support of and in harmony with HRT that all accidents are preventable provided there are measures in place and they are implemented. Hence, it is possible for organisations to move from normal accidents to high reliability organisations and provide safe working environments. The seminar that was held in 2008 established that Anglo American was using WRAC as one of its risk assessment tools (Anglo American: MMMA Safety Summit Seminar 2008:32). In chapter 2 it was proposed that WRAC is the risk assessment tool that has made the Australian mining industry one of the safest mining industries in the world.

The study is also in support of Indirect Cost Theory of Accident Prevention that accidents result in indirect costs for organisations yet; they are also preventable by putting safety measures into practice. Although the Colliery is still incurring indirect costs due to accidents; it has managed to reduce some of the costs through the implementation of safety measures and safety investments which are encouraged by Safety Control Cost Theory. The study further identified and highlighted the investments made by the Colliery towards safety which are supported and are in congruence with the Safety Control Cost Theory as the theory suggests that, with continued safety investments, costs can be reduced as accident occurrence opportunities are minimised. Regrettably, this indicates that resources have to be diverted from production activities to safety enhancing activities which in turn will result in reduced production cost as shown in *Figure 5.1* below which was discussed in detail in Chapter 1.

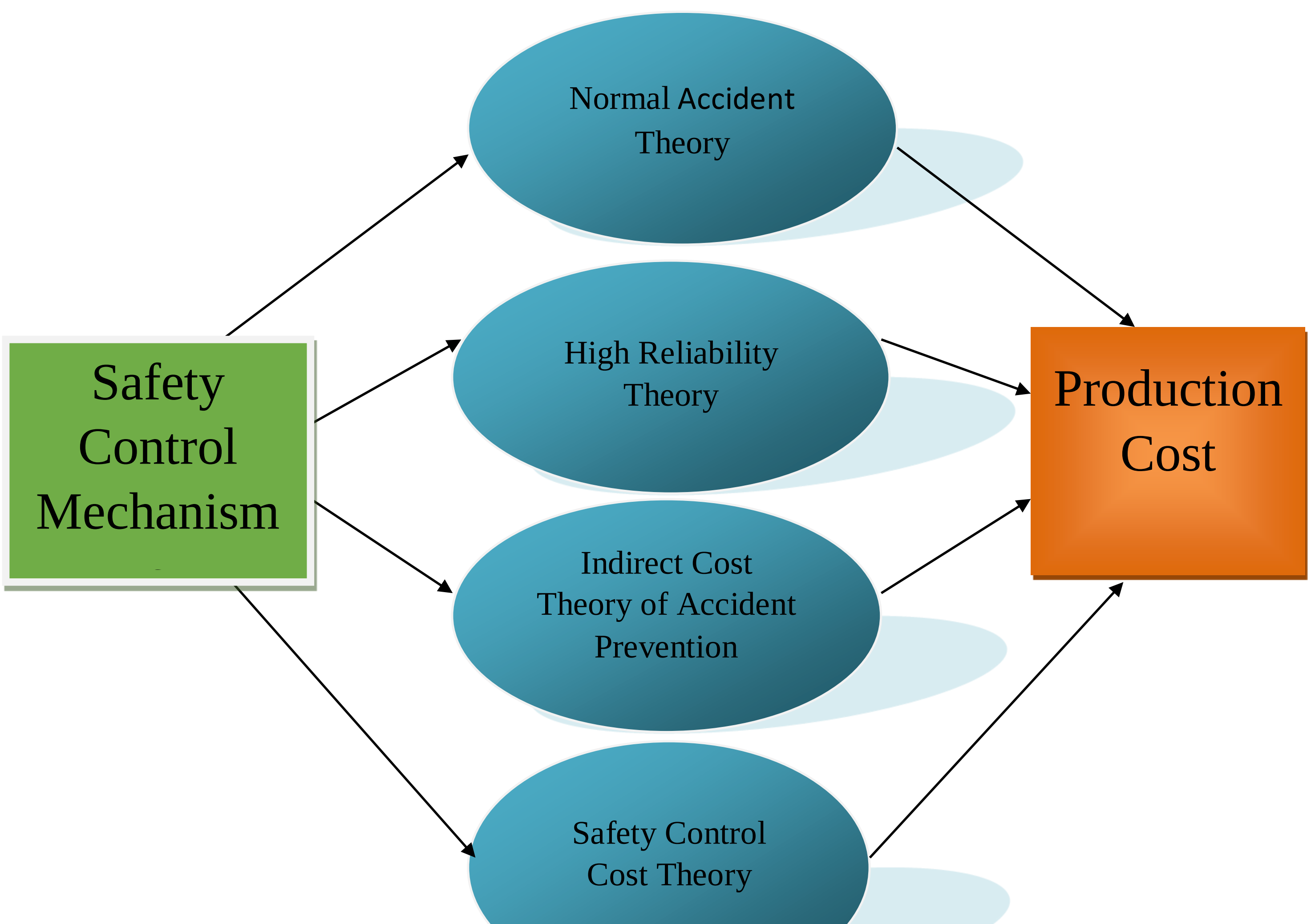


Figure 5.1: Conceptual Framework/Scope

5.6. RECOMMENDATIONS

With regard to the rules that the employees consider to be impossible to apply; it is suggested that illustrations should be given during safety training or safety meetings to ensure that the employees understand what is expected of them with regard to the application of these safety rules. Make the rules flexible, up-to-date, let them be simple, brief, understandable, practical and authentic.

Again, the employees stated that they find rules to be too many and do not know which rules to apply. Based on the aforementioned; it is suggested that the production of more and more rules and procedures to cover all the aspects of the mine should be avoided as they will not be read or comprehended. If they are read they will not connect with the miner. As a result; provision of fewer rules but of high quality is recommended in order to avoid confusion and this could result in a brief and effective mining rules and procedures for the Colliery. It is also recommended that everybody regardless of colour or position in the organisation should admit to, honour and take responsibility for their own mistakes and not shift the blame to the injured employee. This will initiate the process of learning from mistakes, and therefore improve the safety culture within the organisation.

Suggestions regarding the differences identified in 5.4. in relation to the nine dimensions are:

- Attention should be paid to the employees in the Mining and Plant department in order to establish the reasons for these differences as they are the two hazardous production areas of the Colliery.

- Attention should also be paid to experienced employees and those with Excellent English proficiency who seem to be ignorant of the safety measures and the costs associated with work accidents and injuries. This may increase health and safety problems and result in negative economic implications for the organisation
- The retraining of experienced workers to provide information on current safety issues and as a reminder of the importance of safety and the cost implications of accidents. This will provide the means of making accidents more predictable so that they can be avoided easily through the application of safety controls and therefore reduce accidents and accident costs.

Open communication channels with employees in order to understand fully their concerns as this will initiate the development of trust between management and employees so as to get to the root cause of these differences.

With regard to the differences recognised between employees with tertiary qualifications and those without tertiary qualifications, it is recommended that the employees without tertiary qualification should be provided with training and be educated about the various processes within the organisation in relation to safety, hazards associated with their jobs as well as their consequences. This will teach the employees to take responsibility of their own actions and therefore take care of their own safety and the safety of others. Furthermore; concerning the differences between those with Excellent and Poor + Fair English proficiency it is recommended that in order to avoid these differences, safety control mechanisms and training could be provided in a variety of languages, demonstrations regarding the application of procedures, translation of safety rules and procedures, equipment manuals, hazardous materials user instructions and other printed materials related to safety. Where possible, consider the use of images instead of words to ensure that the information provided is understood by all employees.

Employees indicated that supervisors seldom discipline those who break the rules. Based on the aforementioned, it is suggested that supervision should be improved at the Colliery as supervisors are the key men in accident prevention due to the fact that they work closely with the employees and can easily identify critical behaviours. It is therefore their responsibility to correct such behaviours not to ignore them as this can give a wrong impression to other employees that safety is not important as long as they get the job done. Supervisors are responsible for creating a safe working environment for the employees by ensuring application of safety rules, a positive attitude and behaviour in respect of safety and therefore an improvement of the safety climate within the organisation.

It is also recommended that the organisation should ensure and enforce the application of safety rules and procedures in order to reduce the costs that are still incurred by the Colliery.

5.7. SYNOPSIS

At this juncture a cursory look is made at the past researches in relation to safety within the South African mining industry. J. P. Leger conducted extensive research in relation mine safety in South Africa. In 1986 his study focused on the perceptions of workers with regard to the way the work is organised to establish whether or not the organisation of work has any contribution to the high accident rates in the industry (Leger 1986). In 1988 his study with Eisner examined the accident experience in South African mines (Eisner & Leger 1988). They also looked at the international safety rating system as applied in South African Mining (Eisner & Leger 1988). In 1991 he investigated the trends and causes of fatalities in South African mines where he analysed the causes of fatalities (Leger 1991). Other studies like Masia and Pienaar (2011) looked at the safety compliance, Moller (2003) determined the drivers that motivate safety and risky behaviour. Masia (2010) paid attention to the relationship of work stress and safety compliance while Eweje (2005) examined the behaviour and the ethical position of mining companies regarding hazardous employment and health and safety of employees in the South African mining industry. This is the first study that has looked the importance of safety control mechanisms in relation to costs in the mining industry in South Africa. The study has acknowledged that it costs money to implement safety measures but again it takes safety measures to reduce accidents and costs associated with them.

Again based on the fact that the South African mining industry has failed to achieve its safety target of zero harm by 2013 (93 fatalities and 3 126 injuries as disclosed in Chapter 2). It was also stated in the same chapter that South African mining industry is profit oriented hence the study aims to encourage and reveal to the mining industry that although it costs money to implement safety measures; accidents also result in costs which can only be reduced through the application of safety measures. If organisations can do everything in their power to ensure that the safety controls are in place and effective, there can be no accidents and therefore costs associated with them. As a result; safety controls ensure profitability as they reduce the production cost.

The practical implication of the study is that from a management standpoint, the results of this study may enable management to understand the benefits of investing in safety and encourage them to implement safety measures in their own organisations and therefore reduce accident costs especially indirect costs that are said to be four times the direct costs. For organisations that have already implemented the safety legislation the study will assist them to better understand what affects the perceptions of employees in relation to safety within the organisation based on the departments in which the employees work, years of experience, designation, English proficiency and qualifications. The study may also provide management of the Colliery under study and other mines with important hints that may enable them to implement management plans on how to improve safety within their organisations and to meet the needs of employees in different departments especially in the mining and plant departments based on limited English proficiency and qualifications.

Earlier in the study it was highlighted that mining companies do not abide by the legislation because they avoid implementation costs. They argue that safety legislation increases the cost of production resulting in businesses closing down and fewer businesses entering the industry. It was discovered in 1960 at Coalbrook mine that pillar mining was dangerous but still in 2010 six miners died at Marikana mine due to pillar mining. However the new standards and procedures were still ignored due to costs. Hence the 60% safety compliance in South African mining industry. The study will be beneficial to the mining companies by helping them to realise that although it costs money to implement safety measures in relation to training of employees and safety facilities; hazards can be eliminated, emphasis and commitment to safety can improve the safety culture within organisations and therefore prevent accidents and costs in relation to accidents.

As indicated earlier, the study formulated the primary, theoretical and empirical objectives. Those objectives were highlighted again in this chapter and the sections where these objectives were addressed were also indicated. As a result; at this point it can be declared that the study has reached its primary objective which was to investigate the adherence of the Colliery to safety legislation, employee safety compliance and their attitude towards the safety controls and analysis of safety control measures and production cost at the Colliery.

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ANNEXURE 1

Questionnaire

A CONSTRUCTIVE ANALYSIS OF SAFETY CONTROL MECHANISMS AND PRODUCTION COSTS AT A MINE

SECTION A

GENERAL INFORMATION

This section asks for your background information. Please indicate your answer by ticking (✓) the appropriate box.

A1. Please indicate your gender where Male = 1 and Female = 2.

MALE	1	FEMALE	2

A2. Please indicate your Department.

Administration and Finance	1
Human resources	2
Technical services	3
Plant	4
Engineering	5
Mining	6
Protection and safety	7
Redeployment	8

A3. Please indicate your designation.

Top Management	1
Pit Superintendent	2
Assistant Pit Superintendent	3
Safety Officer	4
Safety Representative and other (specify)	5
Foreman	6
Supervisor	7
Operator	8
Other (specify)	9

A4. Please indicate years of experience.

5 years or less	1	Between 6-10 years	2	Between 11-15 years	3	Between 16-20 years	4	Between 21-25 years	5	26 years and more	6

A5. Please indicate your highest academic qualification.

Lower than Matric (lower than grade 12)	1
Matric (grade 12)	2
Certificate	3
Diploma	4
Degree	5

A6. Please indicate your home language.

English	1
Afrikaans	2
Tswana	3
Zulu	4
Sotho	5
Venda	6
Xhosa	7
Tsonga	8
Other (specify)	9

A7. Please rate your English proficiency.

Poor	1
Fair	2
Good	3
Excellent	4

SECTION B

Adherence or compliance with safety legislation

Below are the statements about the adherence or compliance of a Colliery with regard to safety legislation. Indicate the extent to which you agree with the statement by ticking the corresponding number in the 5 point Likert scale below:

		Strongly disagree	Disagree	Moderately agree	Agree	Strongly agree
B1	The organisation is up to date with the safety legislation	1	2	3	4	5
B2	There is a safety policy regarding the safety of employees	1	2	3	4	5
B3	There are safety measures to ensure the safety of employees	1	2	3	4	5
B4	Employees are made aware of possible hazards associated with their jobs	1	2	3	4	5
B5	There are safety procedures to guide the performance of tasks	1	2	3	4	5
B6	There are regular safety control meetings	1	2	3	4	5
B7	Effective documentation ensures the availability of safety procedures	1	2	3	4	5
B8	Safety representatives are involved in putting together the safety procedures	1	2	3	4	5
B9	Personal protective equipment (PPE) is provided freely at all times	1	2	3	4	5
B10	Management learns from past mistakes and implements corrective measures	1	2	3	4	5
B11	Management considers safety to be equally as important as production	1	2	3	4	5
B12	Supervisors seldom discipline employees who break the safety rules	1	2	3	4	5

SECTION C

Employees' compliance regarding the application of safety control measures

Below are the statements about the adherence or compliance of employees at the Colliery with regard to the application of safety rules. Indicate the extent to which you agree with the statement by ticking the corresponding number in the 5 point Likert scale below:

		Strongly disagree	Disagree	Moderately agree	Agree	Strongly agree
C1	I often deviate from safety rules	1	2	3	4	5
C2	I have found better ways of doing my job	1	2	3	4	5
C3	Some safety rules are impossible to apply	1	2	3	4	5
C4	There are too many safety rules that one cannot remember	1	2	3	4	5
C5	Safety rules are written in the language that I understand well	1	2	3	4	5
C6	Employees often give tips on how to work safely	1	2	3	4	5
C7	I have difficulty getting hold of written safety rules	1	2	3	4	5
C8	Safety rules are only for inexperienced workers	1	2	3	4	5
C9	I can get the job done quicker by ignoring the safety rules	1	2	3	4	5
C10	Sometimes I fail to understand which rules to apply	1	2	3	4	5

SECTION D

Employees' perceptions and attitude towards safety controls

Below are the statements about your perceptions and attitude about the safety controls in your organization. You may agree or disagree with each statement by ticking the appropriate number.

		Strongly disagree	Disagree	Moderately agree	Agree	Strongly agree
D1	Safety rules are used only to protect management's back	1	2	3	4	5
D2	Acting with common sense is safer than acting within safety rules	1	2	3	4	5
D3	It is necessary to break the safety rules to get the job done	1	2	3	4	5
D4	Safety rules make easy tasks complicated	1	2	3	4	5

D5	Safety is not my role	1	2	3	4	5
		Strongly disagree	Disagree	Moderately agree	Agree	Strongly agree
D6	Working safety rules remove skills	1	2	3	4	5
D7	Safety rules always describe the best way of working	1	2	3	4	5
D8	Sometimes I do not understand why I have to follow the safety procedures	1	2	3	4	5
D9	I feel like my safety matters to the organisation	1	2	3	4	5
D10	The blame for accident is always placed on the injured employee	1	2	3	4	5

SECTION E

Safety control measures and production cost

The statements below are about the safety control measures and production cost. You may agree or disagree with the statement by ticking the appropriate number.

		Strongly disagree	Disagree	Moderately agree	Agree	Strongly agree
E1	Safety control mechanisms increase production cost	1	2	3	4	5
E2	Safety measures at work have reduced the cost of fatalities	1	2	3	4	5
E3	Safety measures have reduced the costs in relation to accidents	1	2	3	4	5
E4	There is a high cost of employee replacement/ substitution due to dismissals in relation to safety	1	2	3	4	5
E5	There is sufficient resource allocation to ensure adequate safety training	1	2	3	4	5
E6	Work injuries result in a high absenteeism rate	1	2	3	4	5
E7	Suspensions/dismissals result in the organisation paying overtime to the employees	1	2	3	4	5

E8	Safety measures have reduced the compensation paid to employees every year due to accidents	1	2	3	4	5
E9	Adequate safety procedures lead to less damage to property and equipment in the organisation	1	2	3	4	5
		Strongly disagree	Disagree	Moderately agree	Agree	Strongly agree
E10	Equipment lies idle due to injuries/suspensions/dismissals	1	2	3	4	5
E11	Failure to apply safety measures results in employees getting *suspended*	1	2	3	4	5
E12	Failure to comply with safety controls leads to employee *dismissal* from work	1	2	3	4	5
E13	Availability and correct use of PPE helps me to avoid work injuries	1	2	3	4	5
E14	There are safety incentives and bonuses to encourage employees to work safely	1	2	3	4	5
E15	Work accidents result in the loss of production	1	2	3	4	5
E16	My productivity has been affected by an injury I sustained at work	1	2	3	4	5
E17	Competent safety staff ensure a safe working environment for the employees	1	2	3	4	5
E18	Work accidents affect my morale leading to lower productivity	1	2	3	4	5
E19	I was hospitalised due to a work injury	1	2	3	4	5
E20	The organisation provides adequate safety facilities	1	2	3	4	5
E21	The organisation was penalised due to lack of safety	1	2	3	4	5
E22	Employees leave the organisation due to lack of safety	1	2	3	4	5
E23	Small injuries should not be reported as they reduce safety bonuses	1	2	3	4	5
E24	The organisation has received an incentive from the government in relation to safety	1	2	3	4	5

Thank you for your time and cooperation

ANNEXURE 2

ASOKA ENGLISH LANGUAGE EDITING CC

2011/065055/23

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DECLARATION

This is to certify that I have English Language edited the dissertation:

A constructive analysis of safety control mechanisms and production costs at a mine

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It is hereby certified that the MTech proposal:

EVALUATING THE EFFECTS OF SAFETY CONTROL MECHANISM(S) ON PRODUCTION COST AT NEW VAAL COLLIERY

by CECILIA MOTHEMBA PHOHLO

(STUDENT NUMBER: 20314558)

has been edited by me.

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ANNEXURE 3

Employees' perceptions of safety control mechanisms and production cost at a mine

Mothemeba Mokoena *

Merwe Oberholzer **

Abstract

The purpose of this study was to determine whether the requirements of safety legislation are observed and complied with by a single colliery in South Africa and its employees to ensure safety and maintain an accident-free working environment. From the literature, a framework including the following four main components was identified: (1) organizational adherence or compliance to safety legislation, (2) employees' compliance regarding the application of safety control mechanisms, (3) employees' attitude towards safety control, and (4) production cost's relation to safety control mechanisms. An analysis of organizational safety control mechanisms and production cost was conducted through the use of a structured questionnaire, completed by 151 participants. Descriptive statistics, exploratory factor analysis (EFA) and one-way analysis of variance (ANOVA) were utilized to analyze the perceptions of participants. The contribution of the study is that an enhanced safety control questionnaire was developed with a greater emphasis on production costs; the above-mentioned four-component framework was refined into nine managerial factors; and statistically significant differences between the perceptions of different classes of labor (departments) were revealed.

Keywords: Colliery, mine, production, production costs, safety, safety controls

JEL classification:

*

**

Introduction

In South Africa, mine workers' 'skeletons' litter the mines due to accidents. The bodies of some of the miners who have died underground have never been retrieved and buried according to African traditions. This is because, in the course of meeting customer demands and managing unpredictable daily business operations, safety controls are often overlooked (Noe, Hollenbeck, Gerhart & Wright, 2006).

Safety controls are the methods, procedures or standards used to ensure the safety of employees. This can be achieved through the elimination of hazards that could affect the safety of employees (Lu, Zhang, Tang & Gong, 2015). To ensure safety especially in the mines, the government provides guidelines through the legislative framework that includes the Mine Health and Safety Act and Regulations Act No. 29 of 1996, Occupational Health and Safety Act No. 85 of 1993 as amended by the Occupational Health and Safety Act No. 81 of 1993, Labour Relations Act No. 66 of 1995 and the Constitution of the Republic of South Africa, which requires a hazard-free environment for every individual including mine workers.

Although the government provides safety guidelines, fatality and injury rates in the South African mining industry are still high (Chamber of Mines 2010). Statistics indicate that between 2003 and 2013, 1 932 miners died and 41 244 were injured while at work (Department of Mineral Resource 2013). This fatality rate is in contrast with counterparts in the same industry in the USA and Australia, which have experienced only 583 and 103 deaths during the same period, respectively (International Labor Office Bureau of Statistics, 2012). Therefore, in South Africa, miners are four to five times more likely to be involved in fatal accidents than in countries such as the USA, Australia and Canada (Hermanus, 2007). Ural and Demikol (2008) declared that fatalities in the USA decreased from 272 in 1977 to 86 in 2000 due to the strengthening of the safety legislations and enforcements. It is evident therefore that South Africa has a long way to go to ensure safety, and therefore mine workers' safety still remains an issue of grave concern (Kohler, 2010).

Production cost is the combination of direct material, direct manufacturing labor and indirect manufacturing costs. Direct costs can be traced in an economically feasible way to a product, while indirect manufacturing costs, e.g. indirect manufacturing labor, are related to the product, but cannot be traced in an economically feasible way. Furthermore, non-manufacturing costs are not part of the costs of the product, for example administrative salaries (Horngren, Datar & Rajan, 2015). It is believed that safety legislation increases the production cost and as a result businesses close down, fewer businesses enter the industry and competitiveness is affected. Trienekens and Zuurbier (2008) maintain that the costs of meeting safety standards are enormous and increase the production cost. Again, lack of safety results in accidents and accidents accumulate costs. This is evident in the case of Impala Platinum in 2009, a mine based in Rustenburg in the North West Province of South Africa. There were ten fatalities due to non-compliance with safety standards, while 126 days lost time were due to safety stoppage. As a result, production declined by 12 percent and refined platinum declined by nine percent. These lower volumes unfavorably affected the unit production cost (Impala Platinum, 2009).

Again, accidents that claimed two lives in 2011 at Harmony Gold Unisel, in the Free State and the Northern Platinum mine in Limpopo in South Africa could have been prevented by adopting automated models that stop wagons from running if there is a problem (Biyase, 2011). However, these calls were ignored due to costs involved. Accidents and loss of life in the mines are due to negligence by mining companies. This was confirmed by the safety audit conducted on 600 high-risk mines in 2009 to determine their compliance with the Mine Health and Safety Act No. 29 of 1996. Only 60 percent compliance was achieved (Sonjica, 2009). In summary, a paramount concern in South Africa is the large incidence of accidents in the mining industry due to a lack of safety, which has resulted in the country failing to reach its safety target of zero harm in 2013 (Department of Mineral Resources 2013/2014).

The importance of this study is that light will be shed on the management of these somewhat contradictory issues, organizational safety control mechanisms and production costs. This study consulted a number of previous, related studies to develop a questionnaire that emphasizes these two aspects. The related studies are Laurence (2005) and Glendon and Litherland (2001), who based their research on the Safety Climate Questionnaire, originally developed in 1980 by Zohar. Cox and Cheyne (2000) assessed safety culture in offshore environments; Donald and Canter (1993) developed a questionnaire, referred to as the Safety Attitude Questionnaire (SAQ) (Harvey, Erdos, Bolam, Cox, Kennedy & Gregory 2002). Another questionnaire was developed and used in the study conducted by Mason, Lawton, Travers, Rycraft, Ackroyd and Collier (1995). From the literature, a framework including the following four main components was identified: (1) organizational adherence or compliance to safety legislation, (2) employees' compliance with the application of safety control mechanisms, (3) employees' attitude towards safety control, and (4) production cost's relation to safety control mechanisms.

The purpose of this study was to determine whether the requirements of safety legislation are observed and complied with within the above-mentioned framework by a single colliery in South Africa and its employees to ensure safety and maintain an accident-free working environment. The investigation is based on employee perceptions in different departments, with the intention of encouraging mining companies to invest in safety and abide by the legislation in order to reduce fatalities and injuries. Furthermore, to increase awareness that although safety is possibly costly in terms of implementation of safety mechanisms, accidents and production costs can be reduced. This study contributes to the body of knowledge by firstly developing an enhanced questionnaire emphasizing the contradictory issues of safety mechanisms and production costs; secondly, to refine the above-mentioned four-component framework into sensible managerial focus points by means of exploratory factor analysis; and lastly, to determine, by means of a one-way ANOVA how these factors differ between departments, which present different categories of labor types.

1. Conceptual scope

Antle (2000) believes that if organizations make investments to eliminate risks, and if the legislation is 100 percent effective, benefits will outweigh the costs. Consequently, the South African government is of the view that safety controls reduce costs and accidents. As a result, the Chamber of Mines remains committed to the ideal of zero harm (Chamber of Mines, 2010). Safety within organizations involves human factors; therefore, the behavior of employees should be considered. If safety measures are put in place, organizations should create awareness, ensure understanding and enforce the application of safety rules (Eweje, 2005). In order to make valid conclusions and recommendations pertinent to this article, four theories were applied, which form the conceptual scope of the study:

- The Normal Accident Theory (NAT) by Perrow (1984) indicates that accidents are inevitable and therefore normal. Shrivastava, Sonpar and Pazzaglia (2009) claim that no matter how hard organizations try to prevent accidents, accidents will always occur and they believe that mining can never have zero risk to safety.
- The High Reliability Theory (HRT) by Segan, (1993) substantiated and, consistent with Weick (2004), declared that if organizations try harder, and apply safety measures, there will virtually be an accident free system despite the complexity of the system.
- The Safety Control Cost Theory by Son, Melchers and Kal (2000) posits that there is a relationship between safety performance and costs. It states that the higher the design and safety levels to be achieved, the lower the overall costs incurred. Therefore, safety investments should be viewed as a means of reducing accidents and cost (Teo & Feng, 2011).
- The Indirect Cost Theory of Accident Prevention affirms that for every accident that occurs, there are indirect costs incurred. Many employers are not aware of these costs and therefore they are not insured (Brody, Letourneau & Poirier, 1990).

To summarize: This study applied the four theories, which mainly assume a relationship between the contradictory issue between safety control mechanisms and production costs, as a conceptual scope to measure its results against. Furthermore, the four-component frame (1) Colliery's safety compliance, (2) employee safety commitment, (3) attitude towards the safety measures, and (4) production cost) is applied as a basis/instrument to determine the perceptions of employees in different departments. To combine these aspects sensibly, the open question is: What lessons can mine managers learn from the perceptions of employees to enhance the management of items included in the four-component frame?

2. Methodology

To fulfill the purpose of the study, a quantitative research paradigm was employed by distributing structured questionnaires to analyze (using descriptive statistics) the perceptions of employees of different departments regarding to the items included in the four-component framework. This is followed by an exploratory factor analysis to break these four components up into sensible factors, i.e. to put items together that belong together according to participants' perceptions, as well as to provide the management of the Colliery with a model to assist in the operating of safety control mechanisms and production costs. The results of the exploratory factor analysis were further analyzed by a one-way ANOVA to determine whether there are any significant perception differences between different departments. The participants were firstly divided into seven strata using proportional stratification. To simplify the results of the study, these strata were grouped together, (1) Mining + Plant, (2) Engineering + Technical services and (3) Administration that comprises administration/finance, human resources and protection/safety). This is because of the differences regarding risk exposure in different departments and this three-group classification represents direct manufacturing labor, indirect manufacturing labor and non-manufacturing labor, respectively. Firstly, mining and plant personnel are directly involved in the physical extraction and processing of coal; secondly, engineers and technical services are not directly involved, but only support the extraction and processing; and thirdly, administration personnel are by no means involved in the extracting and processing of coal.

2.1. Target population and sampling procedure: The population was restricted to a single colliery in South Africa and its employees. The database at the colliery reflected 1 023 employees including top management from where the sample was drawn. From this population, a sample of 218 employees (based on 20%) was selected using proportional stratified random sampling. The appropriate number was selected from each stratum to ensure that the sample reflects each group in different proportions with a minimum of 30 participants in smaller strata, which resulted in slightly more than 20 percent in total being selected.

2.2. Data collection: Data was collected using a structured questionnaire with five sections (A-E) as indicated in the attachment. Section A requested the participants' general information. Sections B to D represent the four components in the framework that employed 56 five-point Likert scale questions/items, examining perceptions between 1, strongly disagree and 5, strongly agree. It contained modified questions adapted from the questionnaire by Laurence in 2005 – four questions, and the questionnaire by Glendon and Litherland (2001) – five questions. Eleven questions were obtained from the questionnaire used by Cox and Cheyne (2000) to assess the safety culture in offshore environments. The study also adapted five questions from the questionnaire by Donald and Canter (1993). This questionnaire is referred to as the Safety Attitude

Questionnaire (Harvey, Erdos, Bolam, Cox, Kennedy & Gregory 2002). The remaining seven questions in sections B, C and D were obtained from the questionnaire used in the study conducted by Mason, Lawton, Travers, Rycraft, Ackroyd and Collier (1995). The rest of the questions in section E were developed by the researcher to place a greater emphasis on production costs.

In Table 1, the reliability of the scale was determined by computing Cronbach's alpha and reflected the scores ranging from 0.77 to 0.87 (Zikmund & Babin, 2007). Content and construct validity were established by experts in Accounting and Safety fields to ensure that the questionnaire contains the concepts it intended to cover by enabling the researcher to identify and eliminate problematic questions in relation to wording and the arrangement of questions. Of the 218 questionnaires distributed, 151 usable questionnaires were collected at the end of 2014.

Table 1: Reliability of the questionnaire (Attachment) and results

Constructs	**Cronbach's alpha**	**No. of items**	**Results**	
			Mean	Std. deviation
Organizational compliance or adherence of the colliery to safety legislation (section B)	0.87	12	4.17	0.53
Employees' compliance regarding the application of safety control mechanisms (section C)	0.80	10	2.67	0.69
Employees' perception and attitude towards safety controls (Section D)	0.77	10	2.56	0.69
Production costs' relation to safety control mechanisms (section E)	0.86	24	3.41	0.54

3. Results and discussion

3.1 Descriptive statistics of perceptions based on the four-component framework. Table 1 exhibits the summary of results from the questionnaire (see attachment) based on the measures of central tendency (mean) and dispersion (standard deviation). A detailed analysis indicated the mean and standard deviation of each item found in the questionnaire. Section B ranked the highest with the mean score of 4.17 on the five-point scale, which indicates that participants' scores were between agree and strongly agree regarding compliance of the colliery with safety legislation. Section E's mean score is between moderately agree and agree (3.41), which indicates the degree (above average on the 5-point scale) that participants experience the production-costs-safety-control relationship. Sections C and D are between moderately agree to disagree (2.67 and 2.56, respectively), implying participants experience that employees' compliance with and attitude towards safety are less than 3, the midpoint on the five-point scale.

The results of section B can be interpreted that the colliery is perceived to be compliant/adherent with the relevant safety legislation. Some organizations may still be adherent to and consistent with the Normal Accident Theory, but the colliery proved the opposite by implementing safety control mechanisms to prevent accidents. This indicates that the colliery is in harmony with the High Reliability Theory that accidents are preventable and organizations can move from normal accident to high reliability organizations. However, while the colliery (organization) tries its best to be compliant with safety mechanisms, the employees' compliance with and attitude towards safety fall under suspicion (sections C and D). To some, safety is costly; however, they fail to realize the burden created by injury and fatality costs. The results in section E can be interpreted that indirect costs are still incurred at the colliery due to accidents; nonetheless, certain costs have been reduced. This supports the Indirect Cost Theory of Accident Prevention that accidents result in indirect cost yet they are preventable through safety investments that are encouraged by the Safety Control Cost Theory, which believes that the higher the safety investments, the lower the overall cost will be.

3.2 Factor analysis. The data were further analyzed to determine the underlying dimensions under each section using exploratory factor analysis. Kaiser's criteria – eigenvalue >1 rule was utilized to establish the number of factors (Williams, Onsman & Brown, 2010). Items that loaded onto more than one factor, those that loaded below 0.5 and the factors that loaded less than three items were rejected (Field, Miles & Field, 2013). Nonetheless, the questions that loaded onto more than one factor were allowed to represent the factor with the highest loading provided it is >0.5. The nine factors identified and retained are shown in Table 2. Cronbach's alphas for extracted factors were all above the acceptable level of 0.70, except for two factors that were below the benchmark level (0.49 and 0.44). The factors were numbered according to sections, for example: BF1 refers to factor 1 under section B and is interpreted below. The specific questions/items that are grouped into a factor are also indicated in the questionnaire.

Table 2 Names of factors, percentage of variance explained and reliability

Factor number	Names of factors	Percentage variance explained	Reliability
BF1	Organizational compliance to safety legislation	49.12	0.92
BF2	Management commitment	12.27	0.49
	Cumulative %	**61.46**	
CF1	Employees' compliance and commitment to safety	41.91	0.86
CF2	Supportive work environment	17.78	0.44
	Cumulative %	**59.69**	
DF	Employees' perceptions on safety culture	45.95	0.90
	Cumulative %	**45.95**	
EF1	Indirect cost of work accidents and injuries	25.36	0.84
EF2	Perceptions in relation to direct cost of unsafe work environment	13.51	0.87
EF3	Work environment in relation to safety	9.63	0.68
EF4	Cost reduction due to adherence to safety	7.89	0.71
	Cumulative %	**56.39**	

B Factor 1: Organizational compliance with safety legislation (nine items) – Yapp and Fairman (2005) define compliance with safety legislation as activities carried out to maintain a safe workplace by adhering to procedures as required by legislation.

B Factor 2: Management commitment to safety (three items) – Michael, Evans, Jansen and Haight (2005) define management commitment to safety as the dedication of management towards safety and concern for employees' well-being.

C Factor 1: Employees' compliance with and commitment to safety (seven items) – Safety compliance refers to the carrying out of work in a safe manner in accordance with the safety rules and procedures. This requires skills and an understanding of rules to perform work as such.

C Factor 2: Supportive work environment (three items) – This designates the environment where there is support and encouragement in relation to safety (Brown, Raynor & Lee, 2011).

D Factor: Employees' perceptions of safety culture (seven items) – It signifies learned values, shared attitudes, beliefs and behaviors in the workplace (Hadjimanolis & Boustras, 2013).

E Factor 1: Indirect cost of work accidents and injuries (seven items) – Indirect costs are the costs incurred due to accidents, but cannot be directly attributed to the accident as they are not easily measured (Shalini, 2009).

E Factor 2: Perceptions in relation to direct cost of unsafe work environment (six items) – In an unsafe environment, employees are involved in unsafe acts and risky behavior, which result in accidents and direct costs (Shalini, 2009).

E Factor 3: Work environment in relation to safety (four items) – Kidd, Miner, Walker and Davidson (2007) declare that a safe working environment has employees who are supportive of one another in relation to safety.

E Factor 4: Cost reduction due to adherence to safety (three items) – The adherence to safety rules and procedures and the carrying out of every day duties in a safe manner result in cost reduction (Hadjimanolis & Boustras, 2013).

3.3 Perception differences between departments (ANOVA): A one-way ANOVA was computed to determine whether the group means were equal. If significant differences were found, post hoc comparison, based on Turkey's HSD test, was utilized to establish exactly where the differences were found (Clow & James, 2014). Data for this study was collected using the stratified random sampling due to differences in the employees' exposure to risks, namely (1) Mining + Plant (M+P) (n = 63), (2) Engineering + Technical services (E+T) (n = 33) and Administration (Admin) (n = 55). The differences were considered significant if the p-value was less than or equal to 0.05, while a p-value greater than 0.05 was considered not to be statistically significant. The significant differences between the responses of the employees in different strata based on the nine factors identified and explained above are as follows:

Table 3: Post-hoc results using the Turkey HSD test (means indicated in parentheses)

Departmental variances	**Departments**		**Mean differences**	**Std. error**	**Sig.**
B Factor 1	M+P (4.05)	E+T (4.26)	-0.21	0.118	0.164
		Admin (4.53)	-0.48	0.101	* 0.000
B Factor 2	M+ P (3.66)	E+T (4.03)	-0.37	0.153	* 0.042
		Admin (4.04)	-0.38	0.132	* 0.011
C Factor 1	M+P (2.55)	E+T (2.31)	0.234	0.186	0.411
		Admin (2.05)	0.50	0.160	* 0.006
D Factor	M+P (2.48)	E+T (2.05)	0.43	0.186	0.062
		Admin (1.89)	0.59	0.160	* 0.001
E Factor 2	M+P (3.00)	E+T (2.55)	0.45	0.221	0.108
		Admin (2.33)	0.67	0.190	* 0.002
E Factor 3	Admin (4.26)	E+T (3.85)	0.41	0.134	* 0.007
		M+P (4.00)	0.26	0.113	* 0.049

* The mean significance at 0.05 level.

Regarding B factor 1 and B factor 2 (Table 3), it is evident that direct manufacturing labor (M+P) experiences organizational compliance to safety legislation and management commitment to safety, respectively, significantly lower than how non-manufacturing labor (Admin) experiences those factors. This is probably due to a misperception of non-manufacturing labor, since the mining and plant personnel are responsible for the physical extracting and converting of coal into sellable product, which exposes them much more to safety risks.

Regarding C factor 1 and D factor, it is evident that direct manufacturing labor rates their own compliance and commitment to safety and the safety culture significantly higher than non-manufacturing labor does. This is an indication that direct manufacturing labor takes responsibility of their own safety as well as the safety of fellow employees. Direct labor's rating of E factor 2 is also significantly higher than non-manufacturing labor, implying that they are very much more aware of the production costs that may be incurred as a result of an unsafe work environment.

Finally, both direct manufacturing labor and indirect manufacturing labor's (E+T) perceptions of the work environment in relation to safety, as measured by E factor 3, are significantly lower than those of non-manufacturing labor. This is probably the result of operating daily in different environments, e.g. administration offices with fewer safety risks relative to mining tunnels and plants that involve explosives and heavy machinery.

Conclusion

The open question was: What lessons can mine managers learn from the perceptions of employees to enhance the management of items included in the four-component frame? The results of the descriptive statistical analysis of the questionnaire show that the colliery is compliant with safety legislation and in harmony with the High Reliability Theory. On the other hand, employees' compliance and attitude towards safety are somewhat under suspicion. Furthermore, the Theory of Accident Prevention and Safety Control Cost Theory are supported, because indirect costs are still incurred at the colliery due to accidents; nonetheless, certain costs have been reduced. In conclusion, costs are still incurred due to a lack of safety, which requires more emphasis on safety, which may involve the retraining of employees. In addition, the continuous awareness of safety mechanisms and their link to production cost reduction should be enhanced by managers to encourage employees to change their attitude and adhere to safety rules and legislation.

The results of the exploratory factor analysis led to an enhanced four-component management framework. The first component, organizational compliance and adherence to safety legislation, should be broken-up into two focus points, i.e. organizational compliance to safety legislation and management commitment to safety. The second component, employees' compliance regarding the application of safety control mechanisms, should be broken up into the following two focus points, employees' compliance with and commitment to their own safety and the supportive work environment. The third component, employees' perception and attitude towards safety, remains a single focus point. The fourth component, production costs' relation to safety control mechanisms, should be refined into four focus points, i.e. indirect costs, direct costs, the work environment and cost reduction due to adherence to safety.

Based on ANOVA results, managers should become aware of significant safety and production cost perception differences that exist between direct manufacturing labor (and to a lesser extent between indirect manufacturing labor, engineering and technical services) and non-manufacturing labor (administration). Due to the results, the study concludes that the company's compliance with safety legislation and management's commitment to safety still have room to improve to change the perceptions of especially the mining and plant's employees and to a lesser extent the engineering and technical employees. It is therefore suggested that they open communication channels in order to determine the reasons for these differences and the concerns of employees in these departments, as this will initiate trust between management and employees.

The contribution of the study is that an enhanced questionnaire was developed with more emphasis on production costs, relative to previous ones, and nine management factors were identified from the results of the questionnaire and differences between the perceptions of different classes of labor (departments) were revealed. The managerial implication of this study is that the results may enable management to manage the indicated nine focus points/factors, instead of all 56 items in the questionnaire, to improve safety mechanisms and simultaneously get rewarded by lowering production costs. Furthermore, the intensity and urgency of managing the nine indicated factors should be differently applied between departments.

The major limitation of this article is that the results are based on one colliery. Although managers in the mining sector can learn from this experience, the results cannot be generalized as other mines may have different dynamics. Due to production problems at the colliery during data collection and to avoid further production disruptions, the questionnaires were distributed and collected by the section heads. This was found to be a limitation as it may have posed a challenge to the participants to fully disclose their perceptions. Nonetheless, the study provides opportunities for further research. The same study can be replicated and conducted at other mines, and a comparison study can be conducted to determine differences between mines and to enable the generalization of findings.

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ANNEXURE 4

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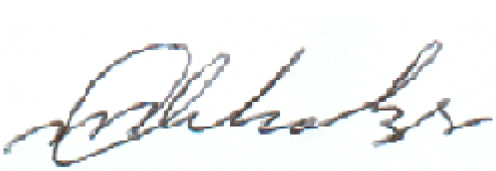

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