

**ASSESSMENT OF OCCUPATIONAL SAFETY AND HEALTH
MANAGEMENT SYSTEM OHSAS18001 ON SAFETY
PERFORMANCE AT HOW MINE.**

BY

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**A RESEARCH PROJECT SUBMITTED TO MIDLANDS STATE
UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF
THE MASTER OF SCIENCE IN SAFETY, HEALTH AND
ENVIRONMENT DEGREE**

MIDLANDS STATE UNIVERSITY

MAY 2017

Dissertation approval form

I **R161121Y** certify that the dissertation is the product of my work and has been prepared in accordance with the guidelines of the Masters in Safety ,Health and Environmental Management programme, Midlands state University. I further attest that this work has not been submitted in part or in full for any other degree at any university.

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Dedication

The work is dedicated to my entire family, wife Junia and children Vanessa, Gracious and Michael whom I had to cut family time to finish the dissertation. Thank you for patience and understanding and encouragement.

Acknowledgements

My sincere gratitude goes to my Supervisor Dr D Moyo for the support, encouragement and guidance during the production of the whole document. May the Lord bless you.

To the entire Management and employees at How mine thank you for the permission and cooperation as well as wealth of information I received during my study. Without you the study was not going to be possible. Thank you for your time and patience when I used to interrupt your daily Schedules for information gathering.

May God bless you abundantly.

Abstract

Occupational Health Assessment Series (OHSAS) 18001 was recognized internationally as an auditable system to manage safety and health risks at workplaces since 1999.

The purpose of the study was to assess the impact of OSHAS 18001 management system on safety performance at How Mine, a gold mining company in Zimbabwe.

The objectives of the study were to analyze the occupational accidents before and after the adoption of OHSAS 18001 and to evaluate occupational injury frequency rate and injury severity rate. As well as assessment of safety practices at the mine, before and after adoption of OHSAS 18001 were done.

The research was exploratory in nature and employed the cross sectional survey design. The sample size used was of 100 participants who had worked for the mine for a period of one year and above on a continuous basis. Stratified random sampling was used due to the diversity of activities at How mine.

Primary and secondary information was obtained through interviews, questionnaires and review of records at the mine. Records analyzed included accidents reports, injuries treated at the clinic, workers compensation claims among others. Correlation and regression analysis were used to test relationships of the independent and dependent variables.

The study found out that the trend of accidents at How mine declined by 90% from 2007 to 2016. Occupational lost time injury frequency rate declined from a high of 14 to 0.3 and injury severity rate declined from 15 to 0.1. Workplaces are considered safe when the injury frequency rate and injury severity rate are below 1. Workers compensation claims for those injured on duty dropped from a high of 31 to 2 for the period covered in the study.

The study concluded that safety performance improved as measured by lagging indicators, such as lost time injuries, injury frequency rate and injury severity rate. The study found out that proactive activities increased during the period reviewed. OHSAS 18001 improved safety performance at How mine in Zimbabwe.

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Abbreviations and acronyms

HSE	-	Health and Safety Executive
ISO	-	International Standards Organisation
ILO	-	International Labour Organisation
OSH	-	Occupational Safety and Health
OHS	-	Occupational Health Services
OHSMS	-	Occupational Health and Safety Management Systems
OHSAS	-	Occupational Health and Safety Assessment Series
NSSA	-	National Social Security Authority
ZCTU	-	Zimbabwe Congress of Trade Unions
WCIF	-	Workers Compensation Insurance Fund

CHAPTER ONE:

INTRODUCTION

1.0 Background to the study

Increasing occupational injuries and diseases led organizations worldwide in developing and adopting approaches to improve safety and health performance. Global estimates by the International Labour Organization (ILO) showed that two hundred and seventy people suffered serious non-fatal injuries and one hundred and sixty million developed illnesses from work related causes. The estimated costs culminated to four percent of the World Gross Domestic Product (GDP) in the past decade. Much suffering occurred to employees and their families due to occupational injuries and diseases (ILO, 2016).The statistics showed great loss and negative impacts on economies worldwide and heavy social impact caused by deaths, maiming and injuries experienced in the course of making a living (ILO 2016).Protection of lives was agreed by governments' world over to be a human rights issue in the vein of decent work agenda by the International Labour Organisation. Occurrences of injuries and diseases arising from occupations impacted negatively on organizations, the individuals affected and, to the family members (Rocha, 2010).Interventions by organization for improving safety and

health performance constituted not only a business excellence motive but a lifesaving motive(Krause, 1993).

The mining industry well known for its risky operations had resulted in death and injuries to the employees when hazards were not controlled at source. Like any other mine How Mine experienced fatal accidents as well as increased occupational accidents in recent years. In the mining industry, companies faced risks that crippled production year in and year out, which in most cases are beyond the budgeted frame of operations. Most companies in Zimbabwe had been crippled by the economic situation in the past decade which had plunged the companies into debts beyond recovery. Hence the addition of occupational injuries and diseases worsened the situation in managing organisations where accidents occurred frequently.

The Wankie coal mine disaster of 1972 was one of the worst ever mining disasters in Zimbabwe where there were four hundred and twenty seven people who died at one time after the explosion in one of the underground shafts. Mining work therefore, fell into the category perceived as dangerous occupation (Chen *et al.* 2014). In the avoidance of injuries and deaths safety measures became paramount in the accomplishment of activities related to mining and ore processing in many organisations.

Strategies adopted worldwide ranged from total quality management, effective management of safety and occupational safety and health management systems (OSHMS) to mention a few (Chang *et al.* 2009).

According to Dalrymple *et al.* (1998) adoption of OSHMS brought success in high income countries, hence the need to assess adoption of OSHMS in a developing country like Zimbabwe.

Increasing economic pressure made organizations to manage their safety and health at work to remain competitive and as a survival mode by reducing any avoidable costs (Vinodkumar and Bhasi, 2011). The occupational Safety and Health Assessment Series (OHSAS) 18001 was globally accepted as an OHSMS, and was published in 1999, based on the British Standard (BS 8800). Many organizations worldwide implemented the system (BSI 2009) to manage safety performance in various sectors. According to De Oliveira, (2013) the OHSAS 18001 was based on the Plan, Do, Check and Act (PDCA) cycle. Due to this fact the OHSAS 18001 standard became compatible with other International Standards like International Standard Organization (ISO) 14001 and ISO 9001.

In developed countries where occupational safety and health management systems are mandatory, success was reported in accident prevention and improvement in productivity in some countries while others had not evaluated the systems (HSE, 2001).The focus of this research was to assess whether the adoption of

occupational, safety and health management system (OSHMS) which are voluntary in Zimbabwe had any effect on safety performance as compared to countries where the implementation of systems was mandatory.

How mine ranks among the large gold producers in Zimbabwe mining industry. Since 2007, the mine incorporated three formal systems in its operations thus the Environmental Management Systems ISO 14001, Occupational Health and Safety ISO 18001 and Quality Management Systems ISO: 9001. The systems were incorporated as business strategies to enhance the vision, mission and values at the mine. Since the systems were incorporated the research sought to assess the impact of OHSAS 18001 focusing on safety performance. Given mining's hazardous nature, the need for development of effective Occupational Safety and Health (OSH) system was deemed vital for organisations to prevent any loss.

1.1 Statement of the Problem

The research was triggered by the occurrence of fatal accidents and other serious accident from 2007 to 2016. The National Social Security (NSSA) Workers' Compensation records (2007-2016) showed that How mine had three people killed at work in 2008.

In the inclusive period from 2007 to 2016 a total of six hundred and fifteen accidents occurred at How Mine, with three of the accidents being fatal. (NSSA

workers' Compensation records, 2007- 2016). How mine adopted the OHSAS 18001 management system hence the research was to find out if there was any impact brought by the adopted system. Increased accidents occurrence in the mining industry was recorded in Zimbabwe as show on the following table.

Table 1: Mining accident statistics in Zimbabwe

Year	Number of occupational accidents
2007	2670
2008	3122
2009	3810
2010	4410
2011	4158
2012	5141
2013	5220
2014	5260
2015	5496
2016	5430

Source: NSSA Annual reports (2007-2016)

These statistics showed that there was a sharp increase in occupational accidents in the mining sector in Zimbabwe. It was against such a background that the researcher wanted to find out what happened at the mine in the period reviewed.

Publications on the effectiveness of OHSAS18001 system which deal with safety and health at work are few in Zimbabwe. Much publication are on the quality system ISO 9001 which had some elements of safety but not as detailed as in OHSAS18001.

1.2 Purpose of the Study

The purpose of the study was to assess the effectiveness and contribution of OHSAS 18001 to safety performance at this particular enterprise against a backdrop where national records of accidents in the mining sector had increased in the past years in Zimbabwe. How mine was one of the few mines in Zimbabwe who had adopted OHSAS 18001 to manage their safety and health.

1.3. OBJECTIVES

1.3.1 General objective

To assess the impact of OHSAS18001, on safety performance at How mine.

1.3.2 Specific objective

1. Analyse the trends of occupational accidents before and after adoption of Occupational Health and Safety Assessment Series 18001.
2. To evaluate occupational lost time injury frequency rate from 2007 to 2016.

3. To evaluate occupational injury severity rate from 2007 to 2016.
4. To assess the safety practices before and after adoption of OHSAS 18001 management systems.

1.3.3 Research Hypothesis

Null Hypothesis: Adoption of OHSAS 18001 had no influence on safety performance at How mine.

Alternative Hypothesis: Adoption of OHSAS 18001 had influence on safety performance at How mine.

1.4 Research questions

What was the accident trend before and after the implementation of OHSAS 18001?

Was there any difference in accident occurrences and occupational injuries before and after OHSAS 18001, implementation?

How was safety and health practices perceived by the employees?

1.5 Assumptions of the Study

The study assumed that there would be no labour turnover caused by retrenchments or retirements which would affect the sample size of the study. The study focused on those who had served from one year onwards on a continued basis at How mine. Another assumption was that the records and other information were to be availed by all managers and employees at How mine. The study also assumed the respondents remained anonymous for truthful rating of the system.

1.6 Justification of the study

Prevalence of occupational accidents was high in many companies in Zimbabwe as per the records of Workers' compensation at the National Social Security Authority. Organizations in Zimbabwe embraced OHSAS 18001 as a way to manage safety and health to reduce accidents at work. Assessment of OHSAS 18001 as a management tool to reduce accidents had very few published studies in Zimbabwe. To the researcher it was vital to carry out the study to provide empirical evidence on the assessment of OHSAS18001 in Zimbabwe.

Adoption of occupational safety and health systems was voluntary in Zimbabwe at the time the study was done, so the study assessed the benefits of self-regulation in managing safety and health at work through the systems approach.

1.7 Significance of the study

The study assessed the relationship or link between safety performance and OHSAS 18001 implementation. Assessment of OHSAS 18001 had not been done through a study; hence the results provided a reflection of what happened at How mine in the reviewed period.

To the regulating Authority like the National Social Security Authority the results provided a measurement of success or failure in managing safety through self-regulation. The study results were deemed to be used for bench marking by other organizations or be a model of managing safety and health through occupational health management systems (OHSMS).

To the academia the study aided in closing the gap in literature on the assessment of Occupational Health Management Systems as a management tool to manage safety at work places. There are few published researches in Zimbabwe on the success or failure of OHSAS 18001 in managing safety and health at work. The study results would aid in closing the gap. The results were assumed to be a spring board for other future researches in various areas of interest. In Zimbabwe the Zimbabwe Congress of trade unions (ZCTU) advocated for studies on social impacts of accidents and diseases and not only to concentrate on the employer's

interest of cost reduction in business operations (June 6 commemoration of Wankie disaster speech by ZCTU 2016).

1.8. Study area

How mine is located 32 kilometres southeast of the City of Bulawayo in Matabeleland South Province, in the Bulawayo Mining District of Zimbabwe. The mine is owned by Metallon Gold Zimbabwe (PVT) LTD.

The production of gold at the time of study was through shaft mining and subsequent processing of the mined ore. The Organisation had various departments which supported the core activity of mining. Other sections like finance, clinic, safety, health, environment and quality (SHEQ), human resources, reduction, security metallurgy and technical service supported the core activities. The work force at the time of the study was 977. Gold ore was mined and processed at the mine before sale at Fidelity printers of the refined gold. Contractors were engaged at the mine for specialised activities like the management of waste in the slimes dams.

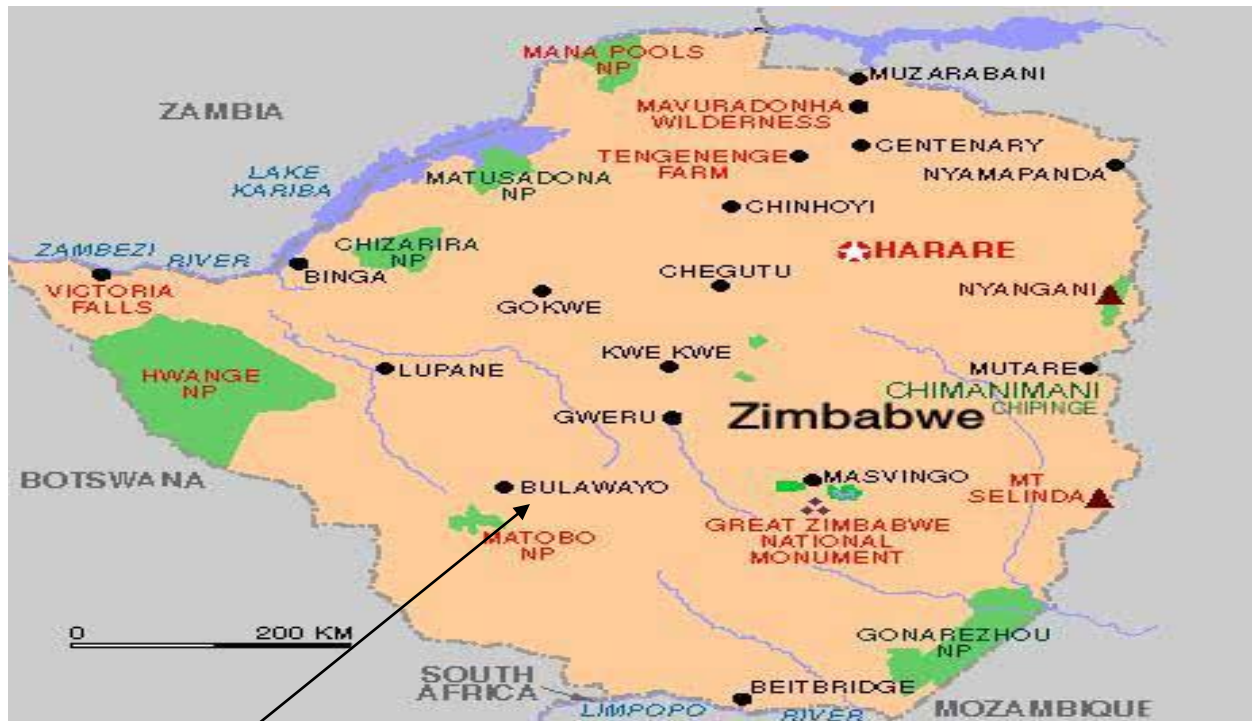


Figure 1: Location of Study Area

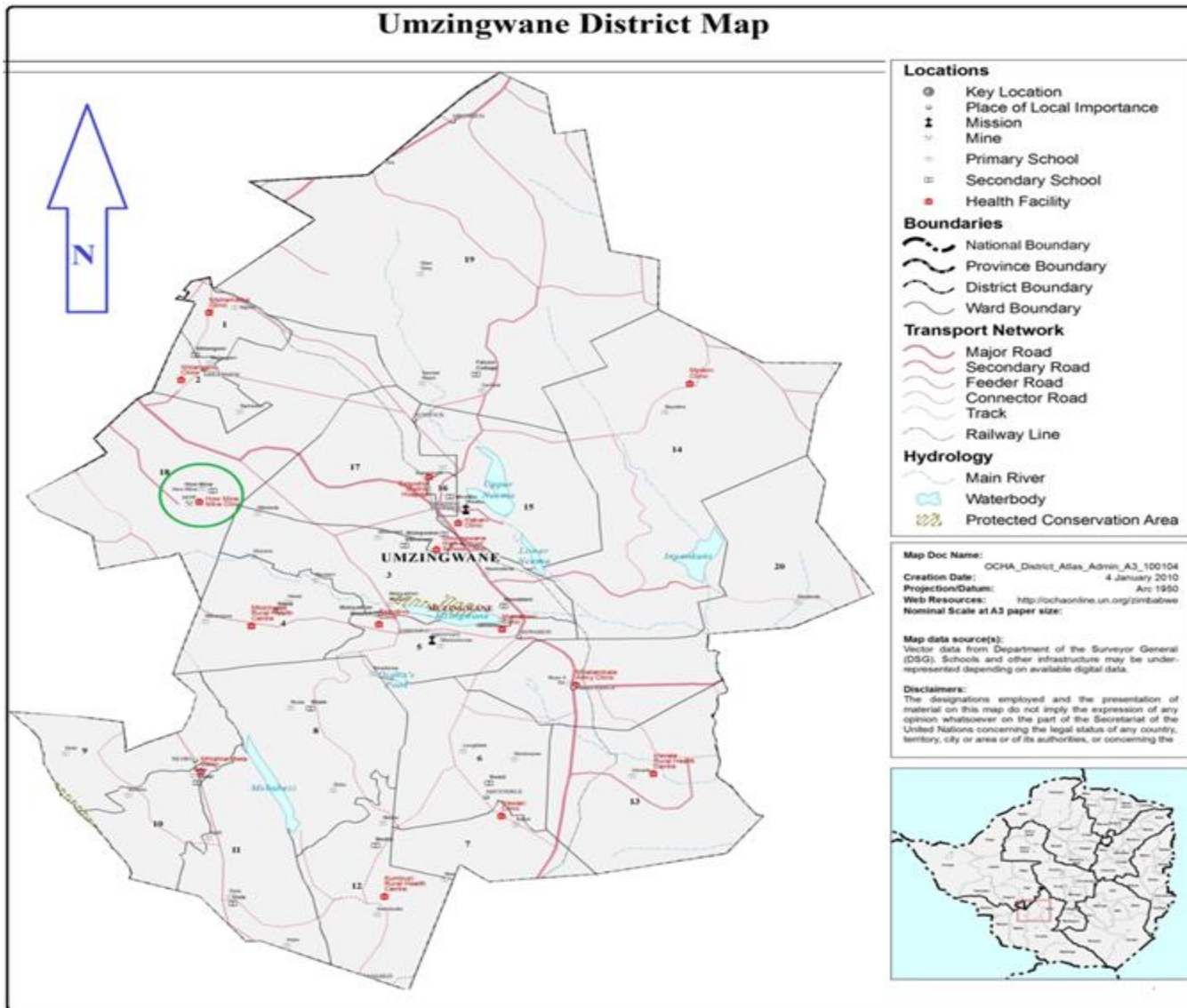


Figure 2: Umzingwane district map

The study area is shown on figure 2 by a circle in green on the Umzingwane district map.

1.8.1. Geographical characteristics of the study area

How mine lies in region five according to the climatologically regions of Zimbabwe, receiving an average rainfall of 490mm per year. Clay rich soils derived from the shale's and red soils characterise the area. The soils have minimal topsoil depth along the horizon making agricultural activities difficult. The vegetation consists of mixed woodland species which are natural around the mine, with the dominant trees being acacia.

1.9. Limitations of the study

Only one mine was studied and was the only mine certified for OHSAS in Bulawayo. A comparison organisation certified for OHSAS18001 could have been studied and results compared. This was not possible due to limited financial and other resources needed for such studies. With the study being cross sectional in nature, information could not be directly observed by the researcher, but there was reliance on information from records and opinions of personnel at How mine.

The information was obtained from managers and employees who were present during the study. Those who were on leave or not at the workplace due to various reasons were not involved. Some vital information could have been missed especially by those who have worked for the mine for a long time.

Records used in the study were found in many departments and were captured not for the purpose of the study and lacked desired detail in some instances. Resources like finance and time caused the researcher to sample respondents in order to complete the study.

1.10. Definition of Terms

Occupational Health and Safety Management System (OHSMS)

Management tools comprising interrelated elements of, policy, objectives, targets and organisation structure, used to achieve organizational goals.

Incident:

A work-related event during where injury, ill health or fatality actually occurs.

Lost Time Injury Frequency Rate (LTIFR)

The total number of injuries, causing employees to be away from work, due to injury or ill health.

Lost Time Injury Severity Rate (LTISR)

The total number of lost work days due to injury or occupational illness in a given period.

1.11. Summary

The chapter gave an introduction of the study, the problem statement, objectives, description of the study area and the justification.

The following chapter focused on literature review of other researches in line with the goal of this study.

CHAPTER 2

LITERATURE REVIEW

Introduction

2.0 Research philosophy

The research took a positivism approach. Easterby –Smith (2002) postulated that positivism approach subjected social facts to objective measurements to deduce a conclusion. The focus of the approach centred on fact finding, generating and testing the hypotheses. The basic belief to the approach was that the external world was objective where application of natural sciences aided in bringing out deductions about happenings in the social world. Analysis of study data collected utilised the statistical models to make deductions or conclusions. Hughes(1980)pointed out that positivism recognised two forms of knowledge, empirical (supported by natural sciences) and logical (supported by mathematics).Positivism generated knowledge about the interactions in the social world and deductions on any domain of study could be made.

2.1. Legal framework on occupational safety and health management systems

The International Labour Organisation (ILO) convention 176 of 1995 on Safety and Health in mines was adopted by various countries and there was proliferation of OSH legislation to curb accidents in many countries. In some developed countries adoption of occupational safety and health management systems (OHSMS) was legislated for and became mandatory. In developing countries like Zimbabwe adoption of occupational safety and health management systems remained voluntary up to the time the study was completed.

In Zimbabwe, occupational safety and health management systems (OHSMS) are covered by article 9 of the Zimbabwe National Occupational Safety and Health Policy of (2014) which advocated for incentives for establishing OHSMS. There still are no clear laws to guide application and OHSMS had remained voluntary.

Management of safety and health at work and measurement of safety performance remained a major global debate since the 19th century to date with different viewpoints by many authors (Suliman 2013). Since the evolution of Occupational safety and health (OSH) progressive strides had been made on safety and health at work dating back from the middle Ages to date. Occupational accidents continued to occur in different parts of the world so prevention strategies are vital for organisations.

According to the International Labour Organization (ILO, 2016) over two million deaths had been attributed to occupational accidents and diseases globally. Effective management in occupational safety and health was a subject agreed globally to be very important at safety congresses and symposiums' (De Joy *et al.* 2010). At annual meetings held every year by the International Labour Organisation governments' world over had agreed on the need to closely manage safety and health in order to reduce injuries, deaths and diseases arising from workplaces.

The aim of this study was to review literature on evolution of safety management and assess the different approaches of managing safety and health at work places. An analysis of two major approaches namely traditional approach and systematic approach in managing safety and health was done as a comparative review. Another aspect reviewed was the safety practices change due to the OHSAS 18001 implementation.

2.2 Evolution of occupational Safety and Health

The information on occupational accidents and disease was scarce in the middle ages. During the middle ages George Bauer(1492-1555) wrote a number of books on mining and metallurgy with the focus of improving ventilation in the mining shafts(Dhillon and Raouf 1994). Later in the 16th century Agricola Paracelsus wrote on the subject of miners' diseases and workmen in dangerous trades(

Hunter 1978). The literature by these writers marked the genesis of information on occupational accidents and diseases. In the 17th century a medical practitioner Bernardino Ramazzini(1633-1714) wrote on safety and health in mining, glass, painting and weaving to mention just a few. In his De Morbis Artificum (The diseases of the workers), Bernadino Ramazzini was the first writer to document adverse effects on health to workers hence today he is known as the father of occupational medicine(Hunter 1978).Ramazzini studied the injury and death rates of many occupations and brought suggestions of preventing and reducing injuries and diseases(Hunter 1978).

These pioneers in occupational safety and health focus were on discoveries of occupational injuries and diseases arising from occupations. They did lay a foundation for current approaches to prevent accidents and diseases. Their work and ideas are being improved to enhance safety and health at work places. In the 19th and 20th century there was little concern on safety and health and any injured worker had to go to the courts to be compensated.

2.3. Theories and models of safety performance and management

2.3.1 Safety and Health management models

According to Herrero *et al.* (2002), organizations used either the traditional approach or the systemic approach in managing safety and health at work. In

traditional approach organizations reacted to outcomes and had measure in place to prevent accidents and diseases. Accident prevention remained the most basic foundation of all safety management paradigms up to the present day. The paradigms in safety management progressed from the reactive approach in the 19th century to the proactive approach in the 21st century (Weil, 2001).

2.3.2 Traditional model of managing safety and health at work

In the traditional approach most safety and health activities are reactive in nature, with much dependence on the safety code of practices and standards, as well as safety regulations. Assumptions were that for any task there are standards which should be followed and laws which regulate the operations. Organizations following such an approach only reacted after the occurrence of accidents with no planned action or anticipation of hazards in operations.

The operations with no codes of practice, clear standards or laws remained unattended as there are no guidelines to manage safety (Kjellen and Larsson, 1981). Reliance on laws and codes of practice as well as standards does not always guarantee improved safety performance as proved by reports from regulating authorities' world over. A study by Frick (2011) noted that Health and safety legislation could only provide a framework or minimum baseline to manage safety at workplaces. The approach and actions of employers, and employees determined whether a safe and health work environment became reality. In

organisations with low or medium risk work environments, enforcement by inspectors was rather a blunt tool to achieve safety performance. The behaviours of persons were critical rather than the pretence to obey safety in the presence of the inspectors.

Near miss incidents which are a product of human behaviours often preceded loss producing events, but are largely ignored because nothing (no injury, damage or loss) happened. In instances where employees were not enlightened to report and document these close calls, prevention opportunities were often lost. The effectiveness of accident prevention at any organisation got stimulated by the quality of information about the causes and circumstances of accidents at work (Arkson *et al.* 2008).

The traditional approach was observed to be reactive to occurrences of accidents and diseases at various workplaces. (Cooper 2001). Information about incidents was very important since after analysing all accidents it became easier to assess the effectiveness of preventive means from accident investigation studies carried by different organisations in the 19th century (Didla *et al.*, 2009). Organizations who used traditional approach missed the opportunities to prevent accidents as argued by Robson *et al.* (2007). Lack of proper documentation of, near misses, minor damage, were apparently a common feature in organizations following the

traditional approach. Safety performance in any organization was determined by the manner management viewed issues or acted (Vredenburg 2002).

Hohnen *et al.* (2011) argued that traditional ways of managing safety were just as good as no prevention at all as nature took its course with little or no intervention. Managing safety and health through reliance on enforcement yielded low success in both developed and developing countries. Studies by Rosenstock *et al.* (2005), pointed out that reliance on traditional approach had resulted in poor management of safety and health in developing countries. Enforcement of laws and regulations was slack world over due to numbers of personnel needed which never matched operating organizations. Reliance on enforcement was viewed as an outdated approach to manage safety in an ever changing work environment by competitive organisations (Gunningham and Sinclair 2007).

2.4 Systematic models

Organisations worldwide experienced paradigm shifts in the manner they managed safety and health at their operations with new dimension being followed continually after new developments. There was promotion of systems approach world over since the beginning of the 21st century. The systems approach brought a number of elements together like, policies, procedures, roles, functions strategies and practices. These elements when combined together adequately

brought forth new methods of managing safety and health hazards in organisations (Gallagher 2000).

Systems approach was the way forward in correcting apparent management failures which occurred when organisations followed traditional ways of managing safety and health at work. Occurrences of disasters like the Piper Alpha oil rig fire accident at the coast of Aberdeen in 1988, where 167 workers were killed because supervisors used short cuts and there were no systems to recheck activities resulted in the disaster.

The other incidents included the Bhopal gas disaster of 1984 in India where immediate deaths were estimated at 2259 people after the accident occurrence (Varma *et al.* 2005) and the Chernobyl nuclear disaster (1986) in Ukraine remained typical examples of failures where conditions were left to deteriorate and with no systems in place which resulted disasters (Mosey 2014).

In Zimbabwe lack of systems resulted in these disasters, such as the 1972 Wankie Colliery Mine disaster which claimed lives of 427 employees (Dupont 1978), the 1999 CABS Millennium Tower Construction site accident which killed 15 construction workers, the Dete train disaster on 1 February 2003 where at least 50 people died in a train accident (NSSA workers compensation records 2004).

According to a study by Zanko and Dawson (2012), systems approach brought identification of hazards which degraded business before the occurrence of accidents. Systems approach studies proved that OHSMS were an effective way to manage safety at workplaces (Rocha 2010).

Systematic approach in managing safety and health had a number of components which included management commitment, participation, communication, training, follows up systems, the condition of the work environment to mention a few (Robson *et al.* 2007). The systematic approach to manage safety and health brought in the idea of occupational health management systems (OHSMS) which has been implemented world over in different work environments. What was found critical in OHSMS success was the employee involvement in decision making to manage safety and health matters. Management commitment which was universally believed by social scientists to be the planning, leading, organising and control buttressed the foundation of total loss prevention. Putting in place policies to manage safety and health was considered as the starting point in directing safety and health activities by many authors. A study by Cunningham and Sinclair, (2015), showed that small enterprises had a very heavy burden of occupational injuries and illnesses as compared to large enterprises because of lack of management commitment.

The study drew out the distinction that lack of resources was the major cause of proliferation of accidents and ill health at workplaces. Makin and Winder (2008) argued that safety performance was determined by management practices not lack of resources. What was drawn from the arguments was that it was not the size of the organisation that mattered most but it was the management practices and systems which determined performance despite the size of the organisation.

A study by Cox and Cheyne (2000) assessed a number of factors from management, individuals and the rules which when combined make a system. The study assessed the contribution of each element to the total achievement of safety performance. Lack in any one of the elements was observed to have caused failure of achieving safety goals and targets. The study recommended that to achieve success all elements had to be function as expected or prescribed.

A Study by Farrington- Darby (2005) showed that the factors became more clearer way in the assessment of the systems as advocated by the author.

In comparison with the traditional approach which operated with ad hoc structures and prescriptions, the system approach integrated a number of elements. A study by Hadjimanolis and Boustras (2013) in Cyprus concurred with the view that management of safety was reliant on management commitment and the involvement of employees for sustainable control of all risks.

Other authors like, Hsu et al (2010) contended that a system had pre-determined plan which was applied in a consistent manner in the entire organisation. Systems in health and safety were proactive in that there was identification of risks and hazards prior to any occurrences of accident or incidents. As well system approach centred on identifiable safety management activities which were separate from the general management (Santos –Reyes 2002).

A study by Gallagher and Underhill, (2012), asserted that the aim of OHSMS was to control risks. Achievement came through participation by all employees and management in any enterprise, as well as having well defined communication process and training. The effectiveness of accident prevention gravitated upon the quality of information on the causes and circumstances of accidents at work places. In organisations where information was not properly documented accidents continued to happen due to the ad hoc nature of prevention strategies.

2.5 Communication model for safety performance

To achieve better safety performance, Vecchio-Sadus & Griffiths, (2004) asserted that communication had to be both internal and external. Internal communication included information to all levels of employees, groups and selected meetings, emails, videos, notice boards, newsletters, poster displays and signage. In successful organisations communication was done on a regular basis to keep all personnel informed about prevention activities.

While external communication included annual reports, publications, and submissions to government on legislation alignment, the information as found by a study Cox (1996) included statutory and non-statutory information. Effective communication was when the recipients understood the information from the sender (De Olivera 2013). In different organisations success of OHSMS anchored on effective communication hence the review of this important component was done. Organisations who adopted OHSAS18001 and had success followed the aspects of the communication model to achieve their goals (HSE 2001).

2.6 Domino theory

The domino theory postulated that safety performance was highly dependent on management control, with the first domino being management control. The study by Frank Bird (1974) pointed out the part played by management control in accident prevention was the key driver in achieving safe workplaces. Where there was lack of control poor performance was dominant in the studied organisations, and the opposite was true for organisations that had real management grip. In other words management control played a major role in safety performance in both OHSAS18001 certified and non-certified companies. Studies by Frank bird (1969) postulated that occurrence of minor accidents resulted in the occurrence of major accidents when the minor accidents were not prevented.

Domino sequence of accident causation theory

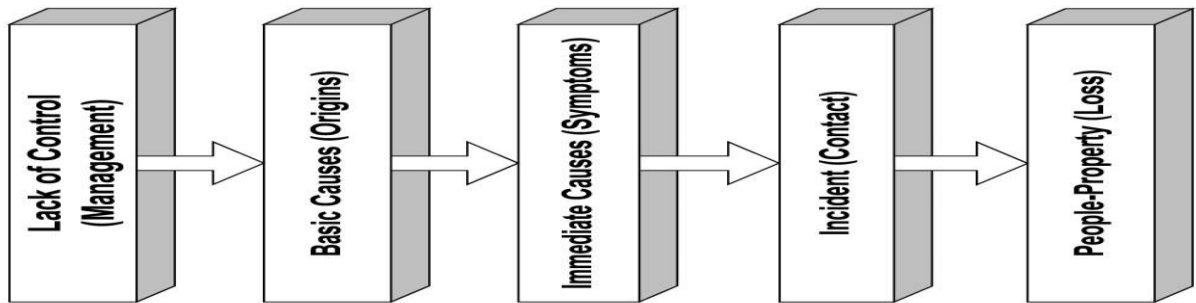


Figure 3: Source: Bird (1974)

2.7 Ferrell Theory

A study by Russell Ferrell (1997) attributed poor safety performance to accidents which occurred when human being had a lot of errors. Factors such as overload, improper execution of task and incorrect responses were major causes of accidents at workplaces. Ferrell postulated that for improved safety performance combination of the environment and mental well-being was vital in the creation of safe work places.

The safety practices (culture) of organizations were defined as the way things are done at a particular place. As such, culture provided a context for action which bonded together the different components of an organizational system in the pursuit of corporate goals (Cooper, 2001). Safety and health practices are a

construct which are derived by the way things are done at any organisation. An encompassing definition was given by Reason (1998) who categorized humans and the organization. Reason (1998) asserted that safety practices depended on values, beliefs, and attitudes which determined the safety performance. The practices had a strong bearing on success or failure of adopted OHSMS.

In organization where policies, procedures were in place, activities undertaken determined the overall safety performance. According to Nielsen (2014) safety practices were a construct of human behaviour which was learned over time.

Safety practices changes were inevitable due to leadership changes which occurred from time to time due to change in strategies and the natural attrition when personnel leave organisations. A study by O'Toole (2002), found out that the human element was key for the success or failure experienced in organisations. The process of communication, reporting, feedback upwards downwards and horizontally had a strong influence on safety practices. Also added was the components of willingness by all to learn and change, and constant situational awareness. Analysis of safety performance without putting the human element left a lot of grey areas as success or failure hinged on human performance.

According to a study by Santos Rees (2002) the behaviour of persons in an organisation had a bearing on the safety performance hence the importance to explore aspects of practices or people's opinions on the subject of OSHMS adoption. A study by Kennedy and Kirwam (1998) confirmed that effective safety and health management was dependent on people starting from the executive management to the lowest employee. However Robson *et al.*, (2007) criticised studies which evaluated behaviour and safety climate as these were intermediate outcomes and were subjective. Reliance on people's opinions was not conclusive hence Robson *et al.* (2007) proposed mixing them with statistical findings which could be proved. In view of the above arguments occupational injury statistics were not thrown away and considered reactive, they provided associations and relationships which measured and proved effectiveness of a system.

2.8.Organisational safety practices model

A study by the European Agency for Safety and Health (2013) indicated that companies were regarded as social communities that shared a set of core values. These core values determined an organisation's identity and underlie the mission, vision and strategies, as well as influence the design and functioning of their style of operation. McKinsey proposed a 7 S-model which organisations could adopt to manage safety practices and enhance their management of injuries and ill health at work places.

All the elements in the model affected the safety practices of an organisation and each element was affected by the resultant culture. Assessment of safety practices was dependent on the personnel skills and their belief in the shared values. Shared values were a product of training style, and system which contributed to the whole strategy of the organisation. Safety performance relied on the effective interactions of the elements proposed in the Mckinsey model (Hayes 2014).

Analysis and quantification of each of the model was found to be a predictor of safety performance by organisations (Goh *et al.* 2013).

In developing safety practices, all personnel were equipped to observe report and correct hazards and risks. Where hazards were identified, the correction was to be made and reported through the hierarchical structure in the organisation. In organizations with better a safety practices, hazard analysis and reporting process was part of routine planning and checking (Vechio-Sadus and Griffith, 2004). Motivations of employees and management were divergent in most instances. In order to infuse safety practices there was need to address the array of motivations in all personnel in organisations. Management in most instances focused on reduction of cost reduction, and employees were interested in prevention of personal injuries and illness arising from the workplace. A match of the two expectations had to be met in most successful organisations (O'Toole 2002).

To achieve behavioural change organizations consistently communicated performance expectations about safety through auditable activities (Blewett, 1994). Good safety practices changes encouraged employees to report near miss incidents and in the process improved safety performance in studies carried out in Europe. Santos –Reyes *et al.* (2002) observed that organisational practices were influenced by the attitudes, motivation and behaviours of managers, supervisors and workers. The influence of work practices modelled the perceptions, understanding and management of safety in OHSAS18001 certified companies. The practices also influenced the assessment of risks in accordance to adopted procedures. Companies which considered safety as less important, in their business, had conflicts between the objectives of productivity and safety. However, in organisations that had positive OSH culture, other business goals and OSH were not seen as conflicting, but as complimentary in achieving overall organisational goals (HSE 2001).

2.9. OHSAS 18001

The Occupational Health and Safety Assessment series (OHSAS) 18001 standard was published in 1999 based on the British standard BS 8800(BSI 2007). The aim of the standard was to minimize OSH risks at workplaces as well as protecting resources (Frick 2011).The OSHAS 18001 standards remain a global OHSMS which was embraced in many countries and was referenced in the current study.

According to a study by De Oliveira (2013) the OHSAS 18001 was found to be compatible with ISO 14001 which deals with environmental management and ISO 9001 which deals with quality. All the three standards were based on the PLAN, DO, CHECK, ACT (PDCA) cycle.

The elements of leadership, hazard identification, and evaluation among others were viewed as critical for the success of adoption of any system by many OSH practitioners. The elements were found to overlap with the requirements of the OHSAS 18001 standard.

2.10. The debate

There has been a debate on the success and failures of OHSAS 18001 all over the world ever since the inception of OHSMS. In other studies success was recorded and in others there were failures, while others were neutral.

2.11. Studies where OHSMS were successful

A study by Dalryple *et al.*, (1998) revealed that adoption of OHSMS was successful in controlling workplace injuries in High income countries.

A study by Honren and Hasle (2011) in Denmark revealed that in large manufacturing business there was promotion and creation of auditable work, and effectiveness of OHSMS was measurable. In Spain, a study by Abad *et al.* (2013) revealed that certified companies in OHSAS 18001 had better safety outcomes

and performance when compared with uncertified ones. Abad *et al.* (2013) study concurred with a study of by Vinodkumar and Bhasi (2011) in India where certified companies had employees with good safety practices and behaviour as compared with non-certified companies.

A study by O'Toole (2002) revealed that there was positive effect on safety performance as injury rates decreased in organisations who embraced OHSAS 18001. The study concurred with that done by Fernandez-Muniz (2009) which revealed low number of accidents and low injury severity were observed in organisations implementing OHSAS 18001 in Europe. Also a study by Bottani (2009) revealed that organisations who adopted OHSAS 18001 had low accident rates in India.

2.12. Studies where OHSMS were a failure

A study by Frick (2011) postulated that, what was on paper and what was practiced differed hence he coined adoption of OHSAS 18001 by organisations as 'paper tigers'. The view was supported by the findings in Taiwan by Chang and Liang (2009) who also argued that OHSAS 18001 certified companies complied regarding paperwork and did not follow the standards. Safety performance was not improved by the adoption of OHSAS18001. In other words these two studies pointed to the fact that OHSAS 18001 was all about paper work and nothing to show in real practice.

A study by European Agency for safety and Health (2002) in Europe revealed that out of eleven companies' effectiveness of OHSMS were noticed in only five companies. More than half of the companies studied showed failure.

The study revealed success and failures in organisations studied where only forty five percent succeeded and the remainder showed failure.

In southern Africa, a study by Eisner and Leger (1998) revealed that the International Safety Rating System was not effective in reducing fatalities and improving safety in South African mines. OHSMS were not of any value as the occurrence of accidents continued.

2.13. Studies which could neither confirm nor deny success and failure

Herrero and Hovden (2011); Junglaret et al (2011); Kongsvik *et al.* (2010); Robson *et al.*, (2007), argued that there was no clear indication that OSHMS provided solutions to all occupational safety and health hazards and risks, and they further argued that there was insufficient evidence to support or be against OSHMS. A study in Singapore by Goh and Chua (2013) pointed out that there was no general agreement on the effectiveness of OHSAS 18001, success was based on speculation.

It was against this background that the study at How mine sought to find on which school of thought the findings would fall in.

2.14 Performance measurement in Safety and Health

In pro-active performance measurement the focus and efforts are to prevent accidents at departmental level (management, employee involvement, innovation and continuous improvement are assessed). Measurement became a key step in any management process and formed the basis of continual improvement. If measurement was not carried out correctly, the effectiveness of the safety and health management programs were undermined and there would be no reliable information to inform managers how well the safety and health risks will be controlled.

According to the HSE (2001), although there was much information available on performance measurement, little looked at safety and health performance measurement. The HSE's experience was that organisations found safety and health performance measurement very difficult, with the majority struggling to develop safety and health performance measurements that were not based solely on injury and ill health statistics. The observation concurred with that of Suliman *et al.* (2013) who pointed out that for the past decades researchers had not managed to agree on a single way of measuring OSH performance. The measurement of safety raised questions such as, Can safety and health be measured by just counting the number of accidents? Or can safety be measured by the size of losses and resultant damages, or by the way workers perceived

acknowledged safety at various work places? (Frick *et al.*2000).Profitability of organisations was measured through metrics like profit or loss which can be easily computed which differed with safety performance measurements.

Measurement as defined by HSE (2001) was the assignment of a numeric to a characteristic of an object or event, which could be compared with other objects or events. The scope and application of measurement was dependent on the context and discipline where measurement was being applied. Contradictions and debates arose on how to convert the safety and health performance to a single numerical measure that depicted the state of occupational safety and health at the workplaces. Different schools of thoughts provided by different authors and agreed that the injury frequency rate and injury severity rates were universal safety metrics which could be objectively computed and proved (ILO 2015).

2.15. Who should measure safety performance?

According to the HSE (2001) Performance Measurement Guidelines (2001), safety and health performance was to be measured at each management level in an organisation, starting with the most senior management. Senior managers had to guard against a culture of measurement of safety and health, by exception, whereby unless a problem was brought to their attention the presumptions were that everything was working as intended. Proactive management undertaken had proved effective in successful organisations.

Organisations decided on how to allocate responsibilities for both active and reactive monitoring of performance at different levels in the management chain. Management determined what level of detail would suffice for proactive prevention. Such decisions reflected the organisation's practices.

Above all the immediate level of control, monitoring had to be more selective to provide assurance that adequate first line monitoring took place. This reflected not only on the quantity but also the quality of subordinates' monitoring. Performance standards were key result areas for managers indicative of how monitoring was done (Abad *et al.*2013).

2.16. Why measure performance?

The primary purpose of measuring safety and health performance in organisations was to provide information on the progress and current effectiveness of the strategies in place. Safety measurement locates and identifies areas of potential hazards to avert risks and disaster occurrences (Akson and Handikusumo, 2008).

The other reason for performance measurement centred on predicting future problems and adopting prevention action which could solve in reducing imminent danger. Safety and health measurement has been used as a decision making tool to decide budget allocation for resources to manage risks (HSE 2001).

Agreed performance measurements by many authors were the incident rate, injury frequency rate and the injury severity rate (ILO 2016). International agreed formulae shown are below.

2.17. INCIDENCE RATE

Incidence rate was the number of new cases per population at risk in a given time period. It is given by the following formula:-

$$IR = \frac{\text{Number of new injuries} \times 10^n}{\text{Number of people exposed to the risk factor during the period}}$$

In OSH measurement it involved computation of the number of new cases of occupational injury or disease multiplied by 10^n divided by the number of people exposed during the reference period.

2.18. LOST TIME INJURY FREQUENCY RATE (LTIFR)

LIFR denoted the number of people injured over a defined time period for each 1 000 000 hours worked by a group of employees. It remained an important indicator of how safe a particular workplace, with the international standard being less than 1 as espoused by the ILO.

$$LTIFR = \frac{\text{Number of lost time injuries} \times 1\,000\,000}{\text{Exposure time}}$$

2.19.LOST TIME INJURY SEVERITY RATE (LTISR)

LIFR were the number of people injured over a defined time period for each 1 000 000 hours worked by a group of employees. It was acknowledged as an important indicator of how safe a particular workplace, with the International Standard being less than 1 for safe work places.

$$\text{LTISR} = \frac{\text{Lost time in days} \times 1\,000\,000}{\text{Exposure time}}$$

2.20. Why using lagging performance indicators?

Lagging indicators remained up to date as the traditional safety metrics used to indicate progress toward compliance with safety rules. These are the bottom-line numbers that evaluated the overall effectiveness of safety and health management measures through informing companies how many people got injured and how badly.

The rates above are legal requirement in some countries. In the case of Zimbabwe, they are a requirement under principle 13 of the Zimbabwe National Occupational Safety and Health Policy (2014), which states that, “All calculations of lost time injury frequency rates for purposes of understanding OSH performance and/or comparing performance within or outside the organization

shall be based on 1 million hours exposure time. All injury severity rates shall be based on a 24 hour day (3 shifts of 8 hours) to provide country uniformity and consistency'' (Zimbabwe National OSH policy, 2014).

2. 21.Knowledge gap

Search of literature revealed no published studies in Zimbabwe which assessed the effectiveness of OHSAS 18001 standard on safety performance in certified organisation. It was the assumption of the researcher that maybe earlier studies were not published or little has been done in this domain.

Hence the study was to provide evidence to add to the body of knowledge and providing a spring board for future researches and information on the debate of whether OSHAS 18001 are effective or not in Zimbabwe.

There remained an apparent the need for industry and OSH institutions to invest in further researches, focusing on existing knowledge gaps in Zimbabwe. Little research had been done on the return on investment of implementing OHSAS18001 by organizations as many resources are channelled when adopting these systems.

Financial indicators like return on prevention were other areas for research to assess the value of OSH interventions in monetary and business terms not merely the belief of accident reduction.

2.22. Summary

The chapter reviewed other studies done earlier focusing on the impact of OHSAS 18001 on safety performance, some studies showed success and others showed failure of OHSAS 18001. The following chapter looked at methodology used in the study.

CHAPTER THREE:

RESEARCH METHODOLOGY

3.0 Introduction

The chapter outlined the research design, sampling techniques, sample size, data collection and procedures followed in Carrying out the research.

3.1 Research type

The research was exploratory in nature; on the assumption that there was very little research on the assessment of occupational safety and health management system OHSAS 18001 either in the manufacturing or mining sectors in Zimbabwe.

3.2 Research design

A cross sectional survey was used to assess safety performance at How mine. According to Saunders *et al.* (2009) cross sectional surveys are appropriate for management and business research with large amount of data to be collected from a sizeable population. In this study, the information was collected through self-administered questionnaires and interviews making the study both qualitative and quantitative.

The cross sectional survey method was chosen because the major components of the research could not be directly observed. Surveys are ideal in collecting both quantitative and qualitative data that are analysed using descriptive statistics.

The other reason for preference of a cross sectional survey was that it enabled the researcher to gather data on a particular subject of interest at a single point in time. Cross sectional survey provided a window or snap shot time horizon where the study was conducted within a specified time. The study explored what happened at How mine during the period reviewed. The study design was more ideal for the researcher to make conclusions by statistical analysis of the finding (Saunders *et al.* 2009).

The research design was also chosen as it allowed for in-depth description of the phenomenon under investigation before and after OHSAS 18001, implementation (Best & Khan 1993).

The other reason for the preference of the study design was that it was the least expensive considering time and budget for the researcher.

3.3 Study population

The study population comprised all the employees and managers at How Mine. The total work force was 977. The target population for the study included all personnel who had served continuously for one year and more, inclusive of

managerial and non-managerial employees. The criteria brought the target population to 632. According to Creswell (2009) the target population comprised the entire set of eligible elements based on chosen criteria.

3.4 Sampling

Stratified random sampling approach and purposive sampling were used to select respondents of the study at How mine. In stratified sampling the population was divided into small groups called stratas using departments at the mine. Random samples were taken from each stratum. In purposive sampling those with needed information for the research were chosen. (Kothari, 2011).

The stratified sampling was preferred as it gave representation of specific sub groups or stratas. Also stratified sampling enabled effective representation of all the sub groups and departments at the mine which were very diverse. Random numbers were used to choose respondents. The random numbers were written on pieces of paper, put in a box and shuffled. Random picking was done to select elements of the sample.

As for other departments with vital information like SHEQ, Human resources, Health services officer and the General Manager purposive sampling technique was used. According to Saunders *et al.* (2009), the method involved selection of respondents where data would be easier to obtain. Records of the

OSHAS 18001 system as well as other records essential for the study were sought in the mentioned departments.

3.4.1 Inclusion criteria

The criteria to identify prospective respondents used was length of service at How mine. Any participant who had been at the mine continuously for one year and above was eligible for the study. Cross reference with human resources records was done to screen prospective respondents.

3.4.2 Exclusion criteria

To improve credible opinions from respondents in the study, all seasonal, temporal and undefined contract employees as well as those who had been at the mine for less than one year were excluded. Balanced opinions by respondents and records reviews on safety performance required time hence in the study the researcher set one year as the minimum considering economic factors in Zimbabwe where labour turnover was not very high during the period of the research.

3.5 Sample size

A sample of 100 respondents was used which was calculated using the formula by Cochran (1977). Calculation was shown on the appendices.

The sample distribution used was as shown below

Table 2 Sample distribution by department

Section	Non -Managerial	Managers& supervisors	Total
Mining	28	2	30
Metallurgy	4	1	5
Engineering	24	1	25
SHEQ	2	1	3
Technical services	1	0	1
Finance	7	1	8
Underground	14	1	15
Human resources	9	1	10
Reduction	2	0	2
Security	1	0	1
Total	92	8	100

3.6 Data sources

Data sources were from primary and secondary sources. Primary data was obtained through questionnaires and interviews. Secondary data was obtained

from records from 2007 to 2016. To complete the study quantitative data and qualitative data was collected.

3.7 Data collection tools

The research instruments utilized by the researcher included questionnaires, interviews, and document analysis. Both qualitative and quantitative approaches were used to collect data. In quantitative approach assertions, facts and claims by respondents were represented in numeric format.

According to Saunders *et al.* (2009) social factors can be analysed using numeric indices to identify relationships or associations. Qualitative data involved collection of opinions and facts collected through interviews or further clarification of documented records.

3.7.1 Questionnaires

Structured questionnaires were used as a quantitative data collection tool. A questionnaire is “a group or sequence of questions designed to elicit information from an informant or respondent when asked by an interviewer or completed unaided by the respondent. The questionnaires were designed to bring out information on , age, work experience and assessment of safety practices before and after OHSAS 18001. The questionnaires solicited for opinions and views on variables such as management commitment, systems to manage hazards at the

mine , consultation and communication to mention a few. Respondents expressed their views guided by the structured questions on assessment of safety performance at the mine.

The questionnaire was chosen as it enabled the researcher to reach those sampled in a short space of time. The questionnaire was designed with most questions to be answered by ticking and had very few questions required narrations (Saunders *et al.*2009). Apart from the advantages, questionnaires have their weaknesses in that the questions may not be understood by the respondents. Another weakness could be of recall as the study needed comparison of information before and after adoption of OHSAS 18001.

3.7.2 Interviews

Interviews were held with SHEQ officers, Departmental managers to get first-hand information on the views about the adoption of OHSAS 18001. According to Creswell (2009) interviews are data collection techniques that involve oral questioning of respondents either individually or as a group.

Purposive sampling was used in choosing candidates for interviewing. The criteria used was based on anticipated information about OHSAS 18001 performance and implementation. Interviews were used to probe in-depth information that would otherwise not be revealed through questionnaires and also to seek clarification to other responses.

The strength of interviews was that they allowed the researcher some degree of flexibility of clarifying questions that were least understood. Also the interviewer could explain or rephrase the questions for clarity.

The weakness of interviews was that those targeted were not be available at agreed times and rescheduling was time consuming.

3.7.3 Documents review

Document analysis was done in order to gather information on number of workers' compensation claims and injuries attended at the clinic. Records from the clinic, human resources, SHEQ department were analysed to gather information required by the study objectives. The information was used to calculate the lost time injury frequency rate and lost time injury severity rates. The accident record book at the SHEQ office was source of information on the total number of accidents which was one of the objectives of the study to explore what happened during the period reviewed by the study. The accident records are legal books which contain all accidents for the mine, month by month and year by year. From the clinic reports, occupational injuries were analysed.

3.8. Reliability

According to Kothari (2011), reliability bordered on the degree of consistency with which an instrument measured the attribute it was designed to measure. To minimize the possibility of unreliable instruments the researcher used pilot testing and retesting. The researcher piloted the instrument on peers of the respondents to check how respondents answered the questionnaire. Data collection instruments are considered reliable if the test results given to different groups under same conditions bring out similar results (Saunders *et al.* 2009).

Pilot testing was done on questionnaires to ensure a satisfactory level of functionality, and to eliminate ambiguities. The respondents chosen for the pilot study were from those who would not take part in the study. Questions were modified for easier understanding after the piloting exercise.

The researcher also interviewed the peers of those who took part in the pilot study in order to check on whether they conceptualised the questions properly using the questionnaire which was to be used in the study. Retesting was done on the data collection instruments by repeating some of the questions using different wording to check whether the respondents' answers were consistent. Statistically reliability was checked using analysis of variance, the averages of results of the pilot study were close to constant the instruments were considered reliable.

The researcher minimised data collector bias by self-administering the questionnaire so that friendliness and support to the respondents was uniform (Kothari 2011).

3.9 Validity

According to Saunders *et al.*, (2009) validity pointed to the degree to which the instrument measured what it truly intended to measure. To achieve validity, the researcher used questionnaires as data collection tool, translation of the questionnaire and selective wording of questions as well as randomization in sample selection.

The researcher considered the questionnaire to be reliable tool in that the respondents were assured of anonymity which enabled the respondents to be free when responding to questions. The questionnaires enabled the respondents time to interpret the questions hence giving valid well thought answers. The assumption was that the same respondents would respond the same way to a different researcher on a similar study.

Outcome of the data collection instruments used also hinged on the understanding of the questions. To ensure valid responses the questionnaire which was written in English was translated into vernacular languages spoken at the mine. This was done for the benefit of those who could miss crucial information because of language.

According to Kothari (2011), content validity referred to the extent to which an instrument represented the factors under study. A statement or word may have different meanings to different groups of people. Therefore for valid answers translated questionnaires were given to content reviewers especially for vernacular languages (Ndebele, Shona and Nyanja) to ascertain the translated words and phrase would be understood by the target population.

The researcher interviewed some of the respondents using the same questionnaire to check on content consistency. The respondents were interviewed by the researcher to avoid response falsehood where interviewees could be chosen from those to be included in the study (Saunders *et al.* 2009). Self-administering of questionnaires was done to eliminate the possibility of including respondents who would have refused to be a part of the study who would fail to complete the questionnaires by the time they were due. A large non response by respondents was going to affect the results of the study. The researcher invested time in random sample selection to ensure randomisation in the selection of respondents to reduce bias. Those who had served for one year and more were the cases and those below one year service were the controls. Appropriate care and diligence was taken for valid results.

Data collection was done in good time without rushing. Time given for data collection had a strong bearing on results. Where respondents for interviews and collection of questionnaires were not found the researcher kept making appointments until all data was collected. Persistence was aimed and making valid conclusions of the study (Saunders *et al.* 2009).

3.10 Data management and analysis

The data was processed and analysed using Statistical Package for Social Scientists (SPSS) 11.5 and excel 2015. Data was entered and coded in the SPSS package where the correlation, association and regression models were derived.

Excel 2015 was used to calculate numbers, mean and percentages from the responses. The data was presented in bar graphs, pie charts and line graphs for interpretation of the results. Where responses had more than one variable cross tabulation was used to interpret the relationships and correlation ships. The Statistical Package for Social Scientists produced graphs, correlations and regression models from the responses. Opinions about safety performance had multivariate variables. Regression models were used to interpret relationships. Findings were presented in tables, and graphs for interpretation and quick analysis.

3.11 Relevance of the study

The study sought assessment of the impact of OHSAS 18001 in managing safety performance in the mining sector in Zimbabwe. Researches in the domain of occupational health and safety management systems were very few in Zimbabwe.

3.12 Ethical consideration

According to Saunders et al. al (2009) research ethics had five principles which are, gaining access, informed consent, anonymity, voluntary participation and confidentiality.

The researcher sought authority to carry out the research from How Mine management and was granted. The researcher explained the purpose of the research to all respondents and got consent from respondents by agreeing to take part after understanding the purpose of the study. For anonymity in the study the researcher used a questionnaire where identity of respondents was not required and was discouraged from being included in the response. The researcher explained to the respondents that participation was voluntary and there was freedom to withdraw anytime if there were any discomforts caused by the study. The researcher assured respondents that all the information of the study was to be kept confidential by the researcher, and any further use for other purposes like publishing the results in journals or any other media consent was to be sought from management and respondents before using the information.

3.13 Summary

The chapter gave the research type and design used in the study. Questionnaires and interviews were data collection tools used in the study. Sampling method used and sample size were described. Reliability and validity as well ethical consideration were described.

CHAPTER 4

RESEARCH FINDINGS

4.0 Introduction

The unit focused on study findings presentation, interpretation and discussion. Collected data was organized and summarized, based on the findings from the field study. Tables, bar graphs cross tabulations, Pearson correlation, and regression analysis were used and the narration was used to interpret the data.

4.1: Questionnaire Response Rate

A total of 115 questionnaires were distributed to employees at How Mine. Normally questionnaires had been known to be characterized by non-response rate so an additional 15 were distributed to make a total of 115. Only 70 questionnaires were returned and 45 questionnaires were not returned as illustrated in table 4.1 below.

Table 3: Questionnaire Response Rate

Targeted Respondents	Number of questionnaires sent	Number of questionnaires Returned	Questionnaire response rate	Questionnaire default Rate
Mining	30	18	60%	40%
engineering	25	16	64%	36%
Finance	10	4	40%	60%
SHEQ	10	6	60%	40%
Metallurgy	5	5	100%	0%
Technical Services	3	3	100%	0%
UIGs	17	6	35%	65%
Human Resource Management	10	9	90%	10%
Security	1	1	100%	0%
Reduction	4	2	50%	50%
Total	115	70	61%	39%

Source: Primary Data

The overall percentage response rate was 61% which was satisfactory given that

participation was voluntary and respondents could withdraw at any time.

4.2: General Characteristics of Respondents

The following table shows the work experience distribution of respondents.

Table 4: Work Experience characteristics of the respondents

N =70

	Frequency	Percent
1- 5years	21	30.0
6 to 10 years	17	24.3
11years and above	32	45.7
Total	70	100.0

Source: Primary Data

30%(21) of the respondents had work experience of one to five years and, 24% (17)of the respondents had work experience of between 6 and 10 years and the majority who contributed 46%(32) had work experience of 11 years and above. This indicates that the respondents were more experienced people and might have observed trends on the safety performance at How Mine.

4.3. Gender characteristics of the respondents

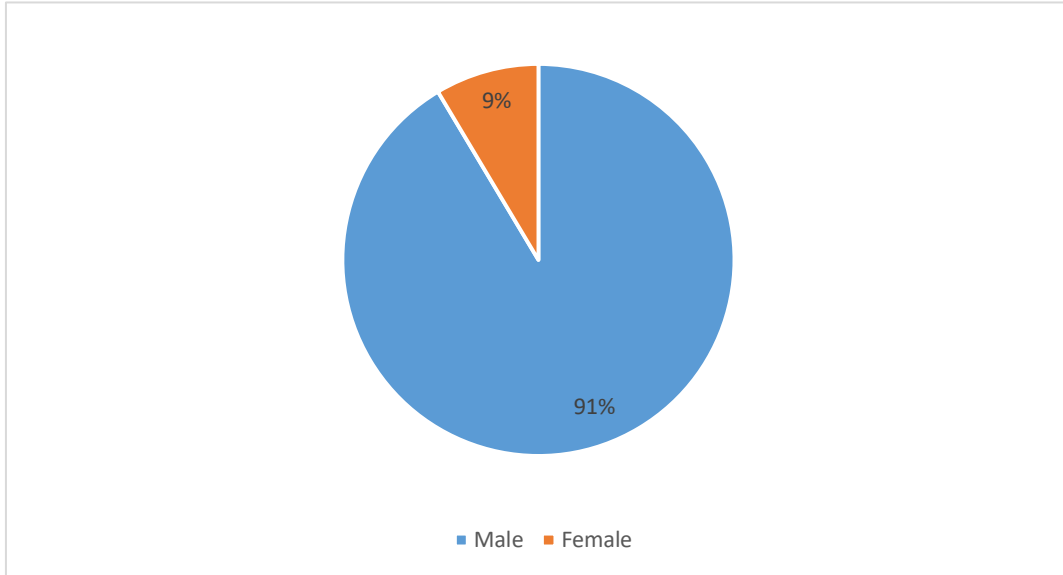


Figure 4.1: Gender characteristics of the respondents

91% of the respondents were males whilst 9% of the respondents were females. This indicated that How Mine is dominated by male employees.

Table 5: Occupation distribution

		Frequency	Percent
Valid	contractor	9	12.9
	employee	61	87.1
	Total	70	100.0

Source: Primary Data

87% of the respondents were employees whilst 13% were contractors. The study respondents were dominated by employees at the mine.

4.4 Total accidents in the past 10 years

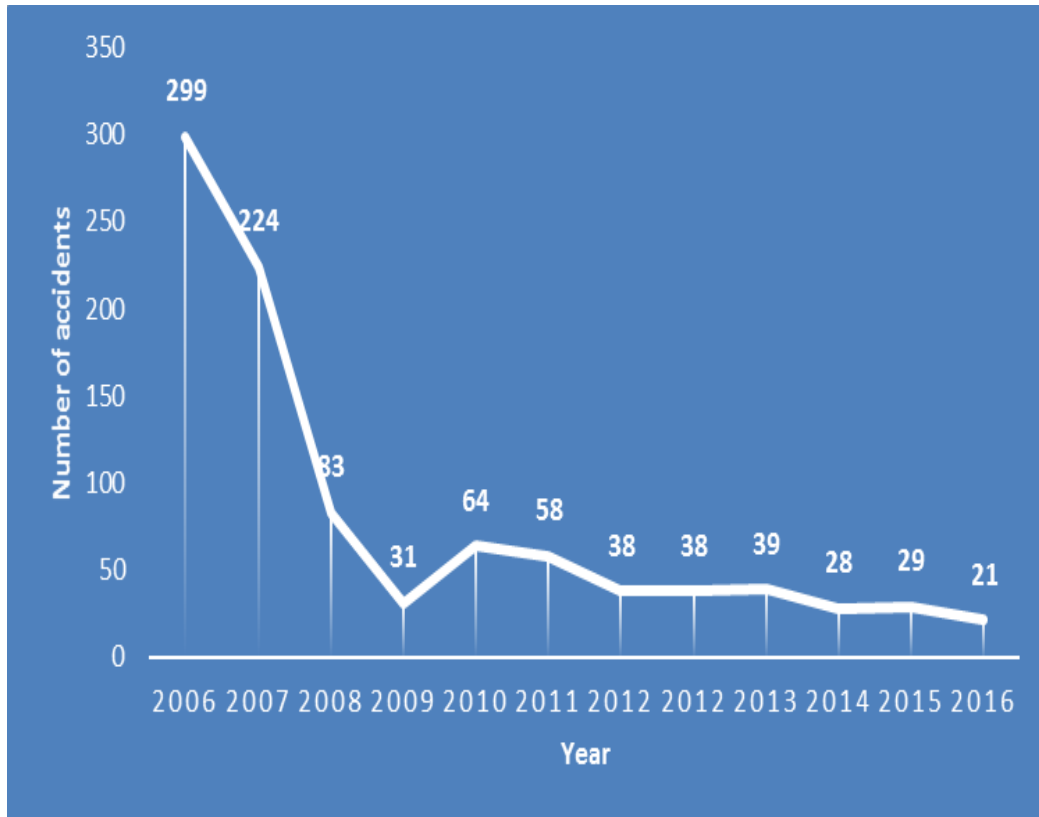


Figure 4.2 Total accidents before and after adoption of OHSAS 18001.

Source: How mine accident records

Accidents records analysis showed total number of accidents from 2007 to 2016. Accidents declined at How Mine from 2007 to 2016. The number of accidents declined from 224 in 2007 to 21 in 2016, which was 90% decline. The trends of accidents during the period reviewed were shown on figure 4.2.

A study by Hudson (2007) asserted that adoption of OHSAS 18001 was a learning process and results were be meaningfully assessed after three years and

more. The arguments of Hudson (2007) were based on the fluctuations in number of accidents found in their studies which were depicted in this study as well.

The findings in the study agreed with findings of Gallagher (2000) who pointed out there was a reduction in accidents in organisation who adopted OHSAS 18001. On the contrary Robson *et al.* (2007) argued that there was no evidence sufficient to make recommendations in favour or against OHSMS.

4.5. LOST TIME AND NON LOSS TIME INJURIES

The following showed lost time and non-lost time injuries at How Mine.

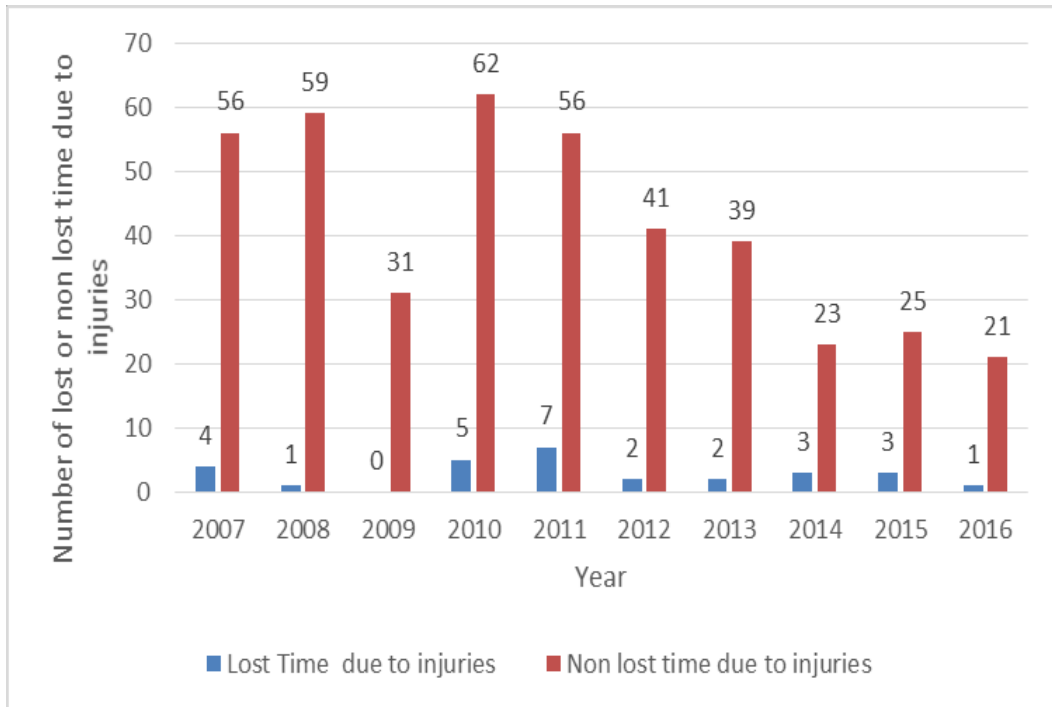


Figure 4.3: Lost time and non lost time accidents

Source: Primary data

The non-lost time injuries were more than the lost time injuries as shown on figure 4.3. Lost time accidents declined from 4 in 2007 to 1 in 2016. Non lost time accidents dropped from 59 in 2008 to 31 in 2009. They increased to 62 in 2010 and then declined to 21 in 2016. The fluctuations as shown on the graph were generally on the decline.

The results of the study agreed with findings of Ma and Yuan (2009) carried out in manufacturing enterprises in China where there was a significant reduction in lost time injuries due to the adoption of the systems approach.

Table 6: Mean occupational injuries before and after OHSAS 18001

4 years before OHSAS 18001 adoption	4 years after OHSAS 18001 adoption
56	35

OHSAS 18001 was adopted in 2011, the average occupational injuries dropped from 56 to 25 in the comparative 4 years period before and after OHSAS 18001 adoption.

4.6: INJURY FREQUENCY AND SEVERITY RATES

Calculations were done to come up with injury severity rate and injury frequency rate. The number of accidents, lost days due to injury and the hours worked by the employees were computed to determine the severity and frequency rate. Formulae used to calculate was as below:

$$\text{LTIFR} = \frac{\text{Number of lost time injuries X } 1\,000\,000}{\text{Exposure time}}$$

$$\text{LTISR} = \frac{\text{Lost time in days x } 1\,000\,000}{\text{Exposure time}}$$

Injury frequency and Severity rate

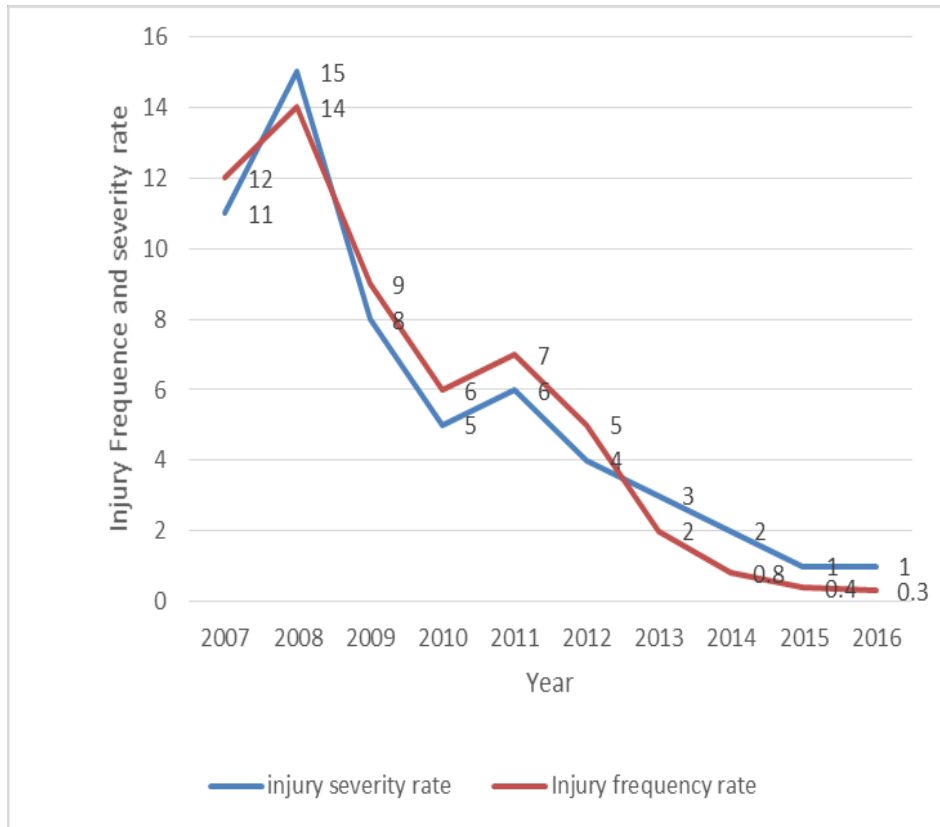


Figure 4.4 Injury frequency and Severity rate

The period between 2007 and 2016 experienced a decline in the injury frequency rate and the injury severity rate. The objective of the study was to evaluate the injury severity rate and the injury frequency rate. The evaluation showed a decline. Injury severity rate dropped from a high of 15 in 2008 to 0.1 in 2016. Three fatal accidents were experienced at the mine in 2008 and the

severity rate was high. The injury frequency rate dropped from a high of 14 in 2008 to 0.3.

4.6.1: Correlation among injury severity rate, injury frequency rate and the number of accidents

The following was the correlation matrix which showed the relationship among injury severity, injury frequency rate and number of accidents.

Table 7: Correlation Matrix-injury severity rate and injury frequency rate

	<i>injury severity rate</i>	<i>Injury frequency rate</i>	<i>Number of accidents</i>
<i>injury severity rate</i>	1		
<i>Injury frequency rate</i>	0.972556599	1	
<i>Number of accidents</i>	0.94451845	0.903280621	1

The Pearson correlation between injury frequency rate and injury severity was 0.97. The results indicated a positive relationship between injury severity and injury frequency rate. The results showed that as the as the injury frequency rate increased the injury severity also increased. The results were similar to findings by Gallagher and Underhill (2012) who pointed out that their studies concluded that there was a linear relationship on injury frequency rate and injury severity rates. Increased injury frequency rate translated to increased severity rate.

The following was the scatter graph from the collected data which showed the extent of association between injury severity and injury frequency rate.

Scatter plot o injury frequency & severity rate

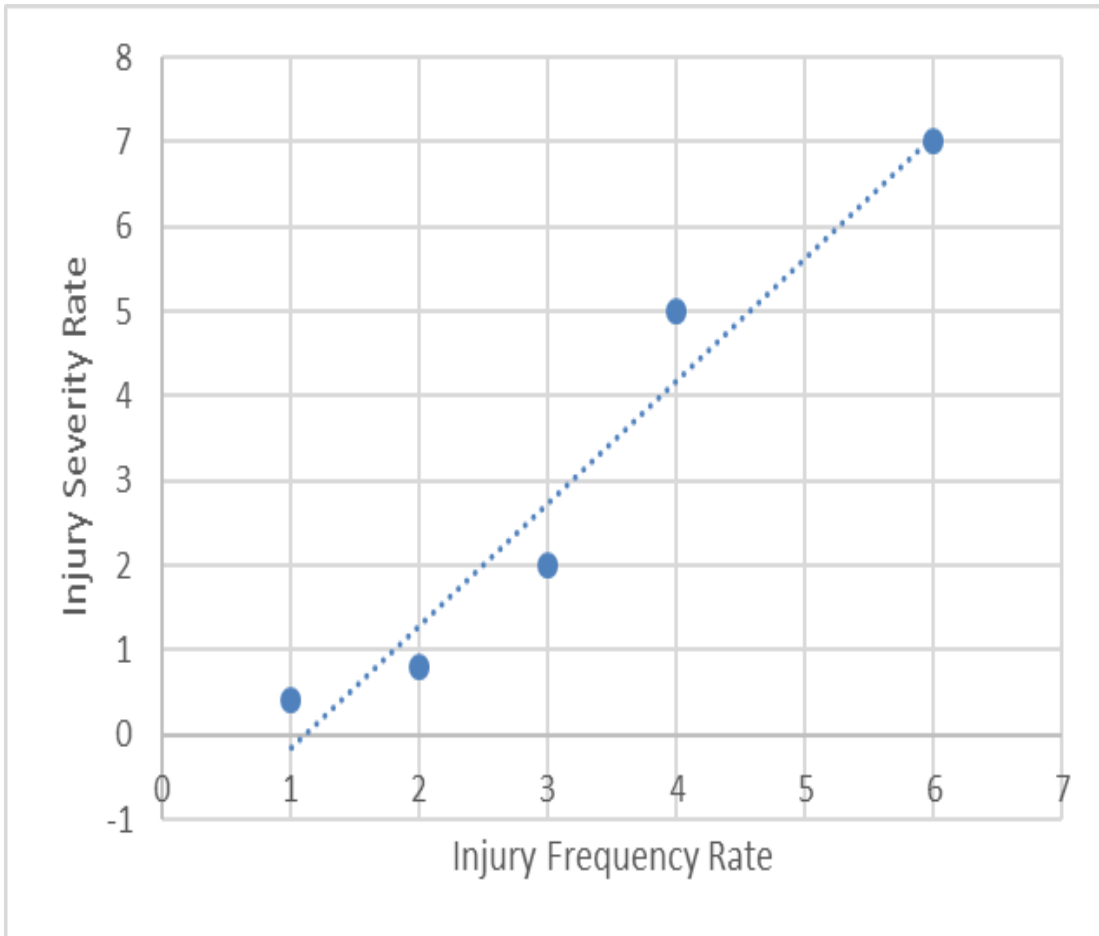


Figure 4.5 injury frequency & severity rate scatter plot

The line of best fit in the graph indicated a positive function of 0.97 and the correlation between injury frequency rate and injury severity. The results showed that as injury as frequency rate increased, the injury severity rate also increased.

4.7: Injuries recorded at the clinic

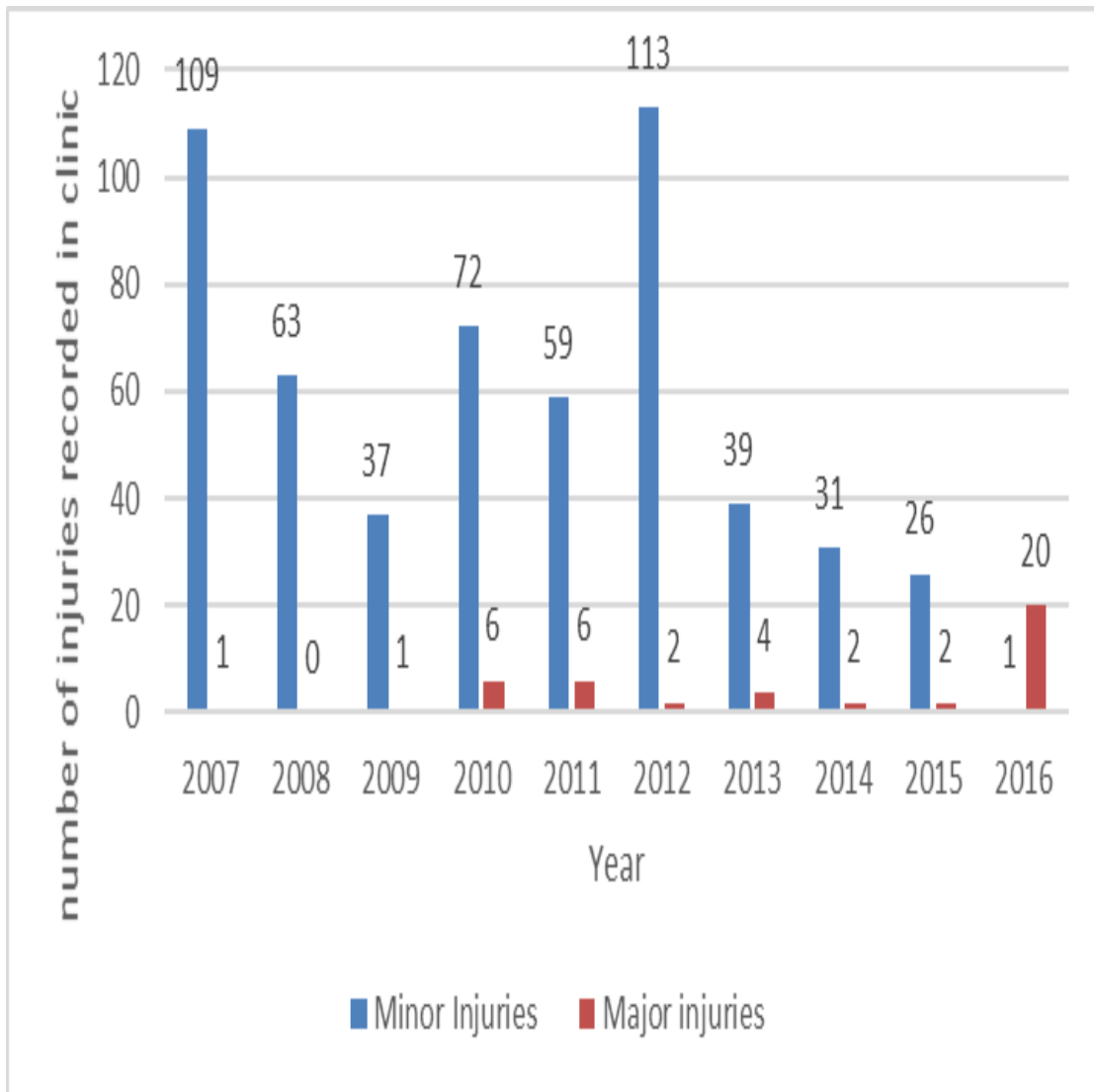


Figure 4.6

From 2007 to 2016, the clinic injuries recorded at How Mine were dominated by minor injuries. The clinic recorded a high of 109 injuries in 2007 and there was a decline to 37 in 2009. The injuries took a peak from 2010 to reach a high of 113 in

2012. The injuries declined to 20 in 2016 as shown on Figure 4.5. Injuries declined by 65% from 2007 to 2009. They increased of 67% up to 2012. Another decline of 81% was observed up to 2016. The results showed cycles of increase and decrease.

4.8 Workers' Compensation Claims

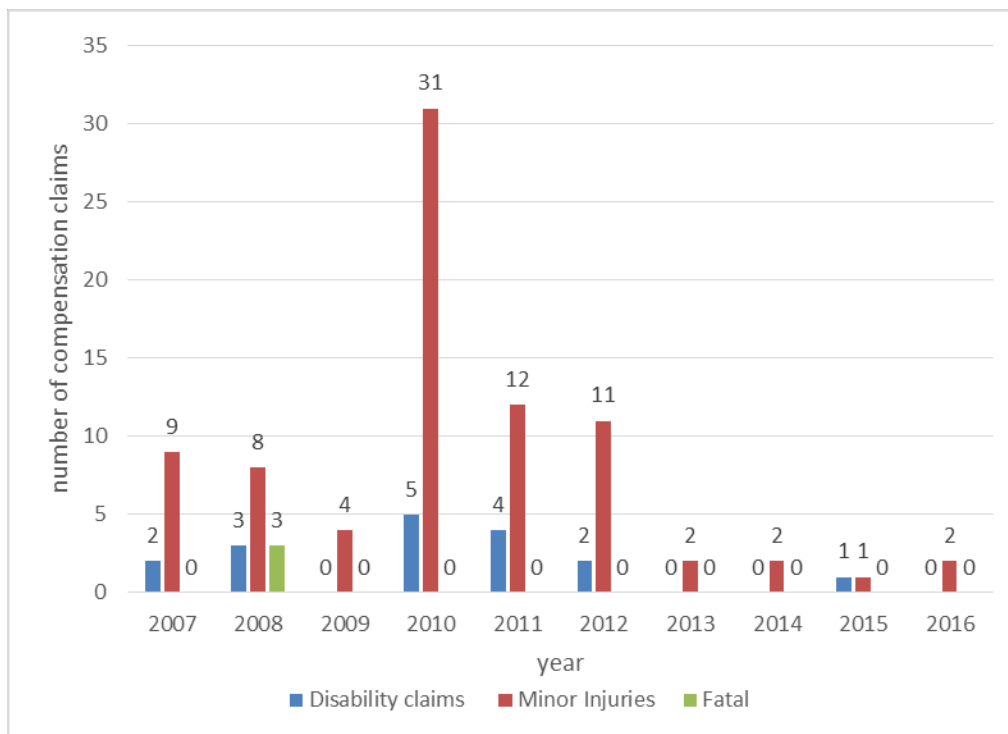


Figure 4.7: Workers Compensation claims 2007-2016

The workers compensation claims from 2007 to 2016 were dominated by minor injuries claims. From 2007 to 2009 there was a reduction in the number of workers compensation claims. The explanation given during interviews was that there was low activity due to economic situation in Zimbabwe during 2008 to

2009 period. In 2010 there was a sharp increase in workers compensation claims. In general the period 2007 to 2016 records showed declined disabling injuries and fatal accidents

Table 8: The correlation ship among the number of claims, number of accidents and the number of injuries

	<i>Number of claims</i>	<i>Number of Injuries</i>	<i>Number of accidents</i>
Number of claims	1		
Number of Injuries	0.533081837	1	
Number of accidents	0.92072617	0.0445063818	1

The correlation between number of injuries and the number of compensation claims was positive with a correlation of 0.53. Increased in injuries resulted in increased workers' compensation claims. The correlation between number of accidents and the number of injuries had a coefficient of 0.044, indicating a weak positive relationship. The high number of accidents did not translate to high number of disabling injuries. The study contradicted findings by Eisner and Leger (1998) who found out that there was a corresponding increase in injuries as the number of accidents increased in South African mines. However this study concurred with that by Abad et al. (2013) which revealed that OHSAS 18001

certified companies in Spain had improved safety performance with low compensation claims and injuries.

4.9 Testing the extent of the relationship between workers compensation claims and number of disabling injuries

Regression Model

Workers compensation claims = a + b (number of disabling)

The r square which was the coefficient of determination of the regression model was 0.84 which showed that the regression model was positive. The number of accidents was a good explanatory variable for the number of workers compensation claims at How mine. The p value for the explanatory variable (number of disabling injuries) was 0.009 which was less than 5% (0.05) which meant that there was statistical significance. Increased number of disabling injuries resulted in increased workers compensation claims. The study findings agreed with findings of Rocha (2010) who found out that there was a significant reduction of health care cost at organization who adopted OHSAS 18001. Analysis of health care cost at How mine claimed through Workers compensation (WCIF 22) dressing account showed that claims had reduced due to the nature of injuries which were mainly minor.

4.10 safety practices change

N= 70

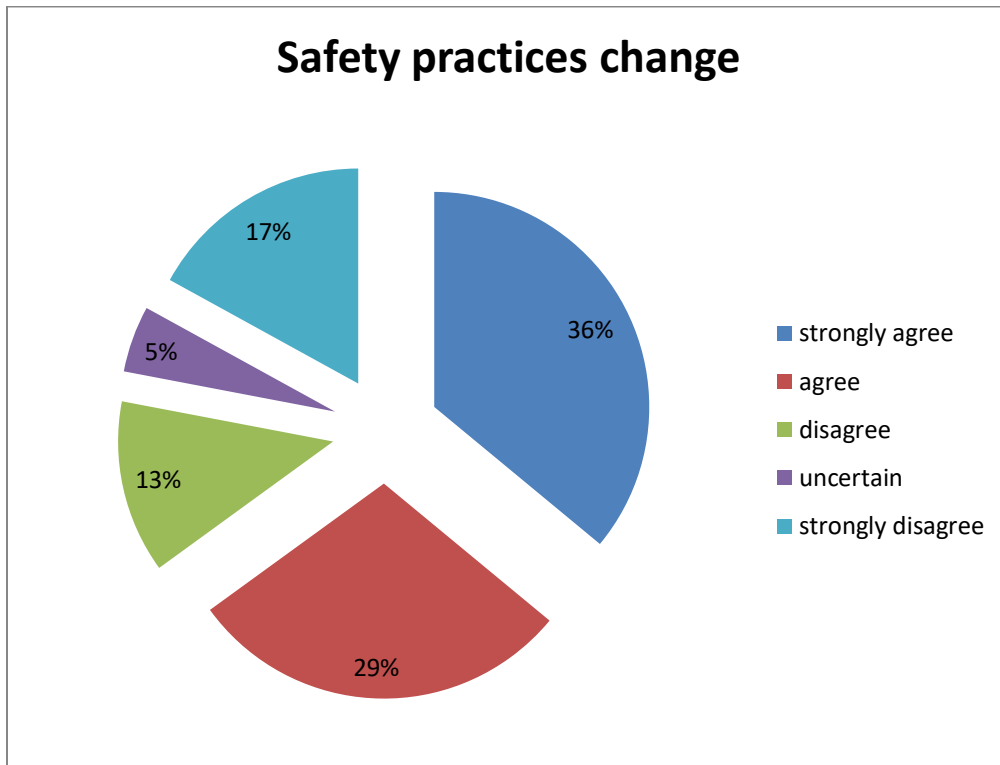


Figure 4.8 safety practices change

36% of the respondents regardless of different levels of work experience strongly agreed with the fact that the organization had changed in safety practices. 29% agreed safety practices had changed since the adoption of OHSAS18001. 5% of the respondents were uncertain of changed safety practices. 13% disagreed of changed safety practices and 17% strongly disagreed of changed safety practices at the mine. As pointed out by a study by De Oliveira *et al.* (2013), who found out that giving a metric number to measure practices which could be proved was

found to be difficult. Results of the study showed that 65% agreed there was a culture change and 30% disagreed.

4.11 Availability of systems to manage hazards

N=70

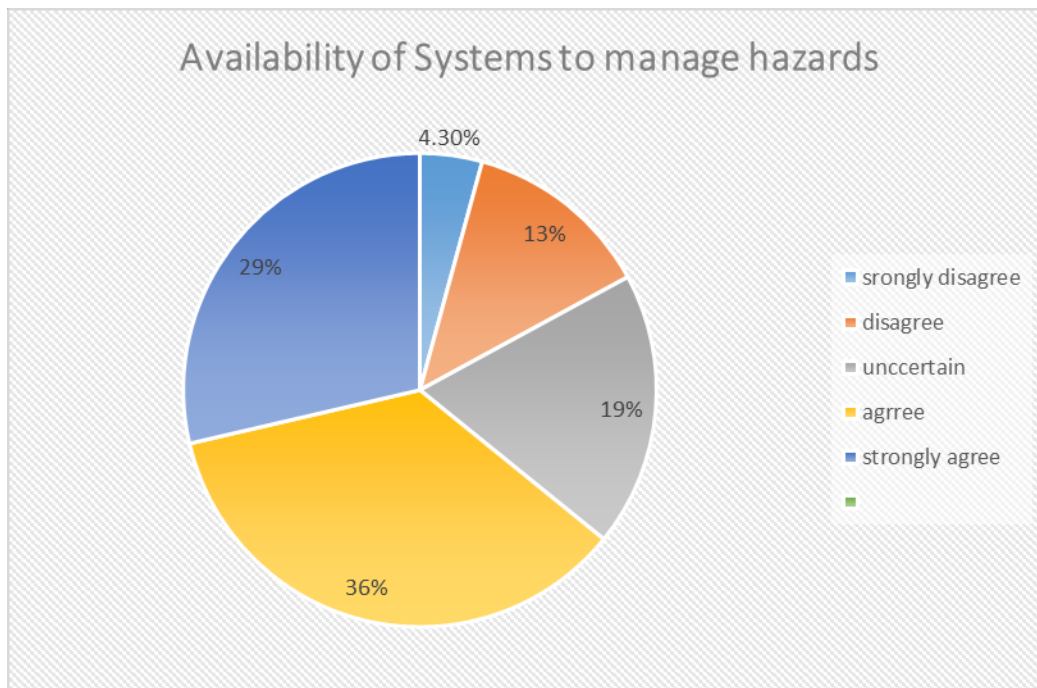


Fig 4.9 Availability to manage hazards

4% of the respondents stated that they strongly disagreed with the fact that there were systems in place to manage hazards, 13% disagreed with the fact that there were systems to manage hazards and 19% were uncertain. 36% of the respondents agreed to the fact that there were systems in place to manage all hazards and 29% strongly agreed that there were systems in place to manage hazards. Those who

agreed were more than those who disagreed of the presence of the systems in place to manage hazards and risk at How Mine.

4.13. Communication and participation practices

Table 9: The extent of communication and participation of employees on safety and health matters

	Frequency	Percent
strongly disagree	2	2.9
disagree	1	1.4
uncertain	4	5.7
agree	36	51.4
strongly agree	27	38.6
Total	70	100.0

Source: Primary Data

Communication and participation: N=70

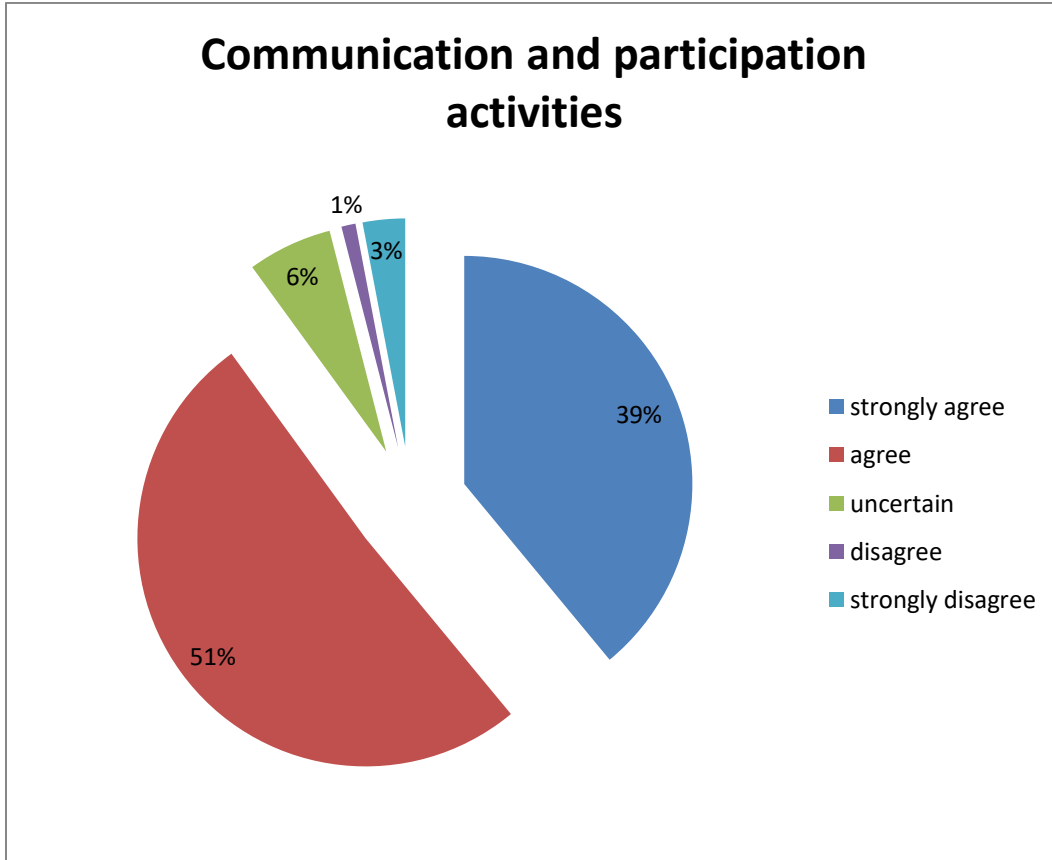


Fig 4.10 communication and participation activities

3% of the respondents stated that they strongly disagreed with the fact that there was communication and participation of personnel in matters relating to health and safety. 1% of the respondents stated that they disagreed with the fact that there was communication and participation of personnel, 6% of respondents were not certain, 51% of the respondents agreed that there was communication and participation of personnel on matters relating to safety and health and 39%

strongly agreed that there was communication and participation of personnel on matters relating to safety and health. The study showed that there was consultative decision making in matters relating to safety and health. The findings at How mine agreed with the study by Rosenstock *et al.* (2005) who pointed out that modelling of a safety practices in an organization was achieved through the human element. Of prominence was the communication, reporting, feedback upwards downwards and horizontally.

4.14. Training, Awareness and competence activities

N= 70

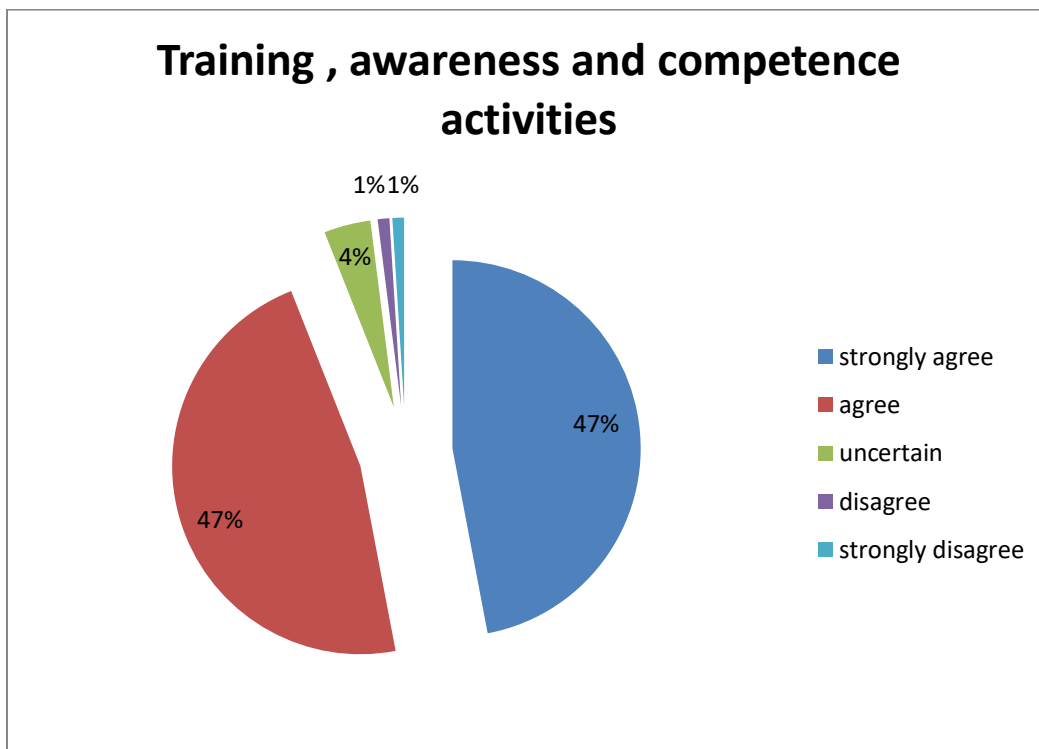


Fig 4.11 Training, awareness, competence activities

1% of the respondents stated that they disagreed with the fact that safety and health training were carried out, 47% agreed with the fact that safety and health trainings were conducted, 47% also strongly agreed that safety and health training were conducted regularly and 4% were uncertain whether health and safety training were conducted regularly. While 1% disagreed that there were training and awareness activities. The results showed majority of employees agreed safety and health training were conducted regularly at How Mine and indicated that safety and health was important at How Mine.

4.15 Management commitment

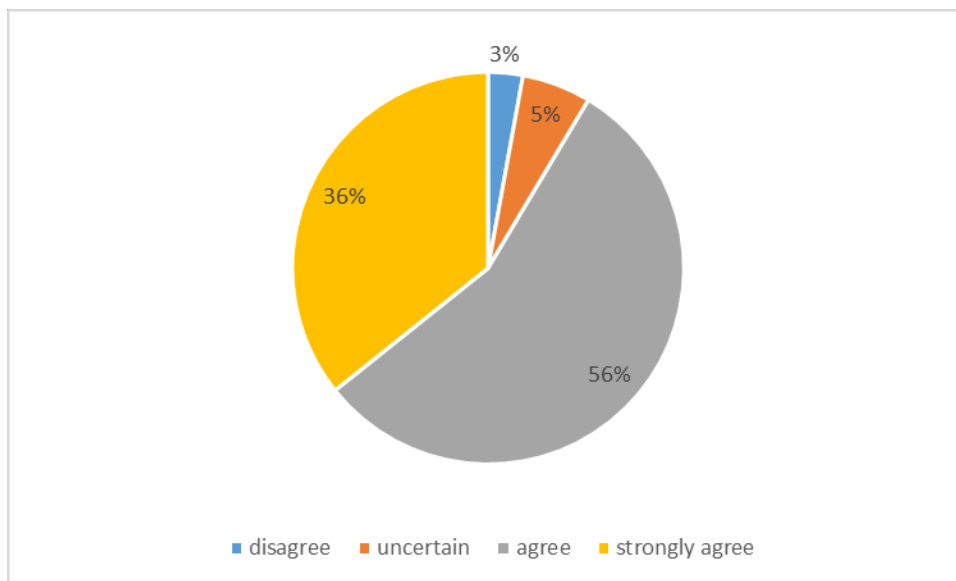


Fig 4.12 Management commitment

36% of the respondents stated that they strongly agreed with the fact that the management was committed to safety and health performance at How Mine , 56% of the respondents agreed that the management were committed to the safety and health performance and 5% were uncertain as to whether management were committed to health and safety performance.3% of the respondents disagreed to the fact that the management was committed to health and safety performance. The majority stated that the management were committed to health and safety performance, this means that health and safety is very crucial at How mine

Findings agreed with a study by Hadjimanolis and Boustras (2013) who pointed out that management of safety was reliant on management commitment and the involvement of employees for a sustainable control of all risks.

4.12 Trend of employees with various levels of experience and accidents

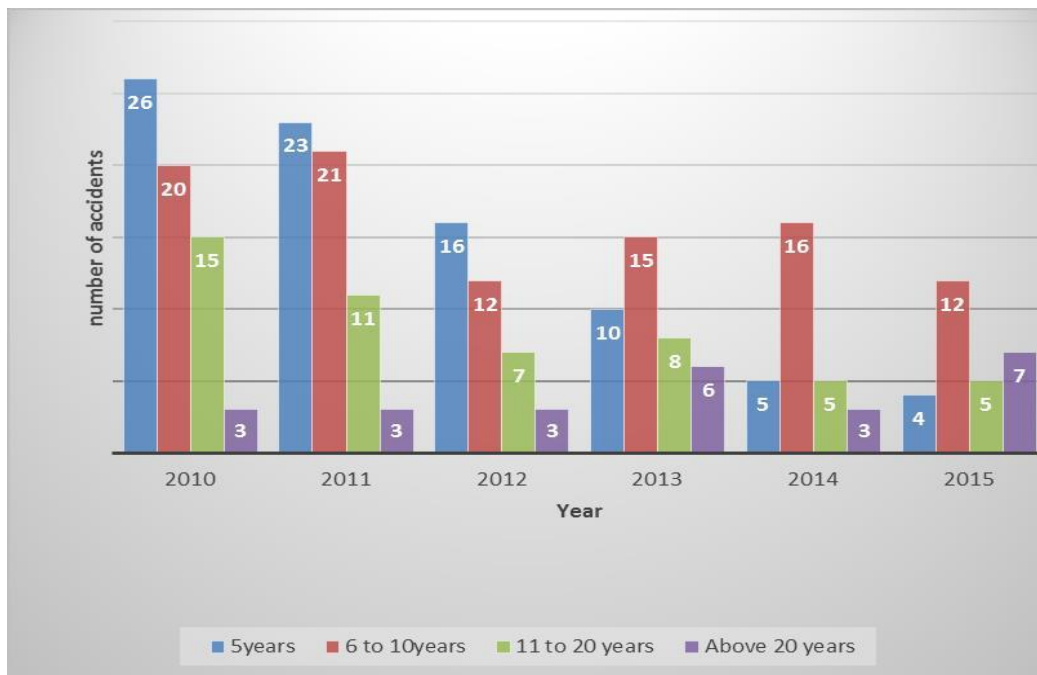


Figure 4.13 The trend of employees with various levels of experience who were affected by accidents.

Prior to 2010 records did not specify experience of those injured. The employees with the work experience above 20 years recorded lesser number of accidents whilst the employees with experience between 1- 5 years recorded more number of accidents. This indicated that those who were less experienced were heavily affected by accidents as compared to the experienced employees

The study revealed that as employees became more experienced with work, they had fewer accidents. The findings was also supported by the social belief postulated by Cunningham *et al.*(2015) who stated that as a person became experienced, maturity and knowledge made employees less vulnerable to accidents. The findings concurred to a study by Breslin *et al.* (2005) who asserted that years of experience at work were found to be a major contributor to fewer accidents. Those with less experience were frequently involved in accidents unlike the experienced ones.

The Pearson correlation test was r was -0.66.

The results showed a negative relationship between the number of accidents and work experience. As employees became more experienced they were less involved in accidents.

4.13. Trends of employees with different ages affected by accidents

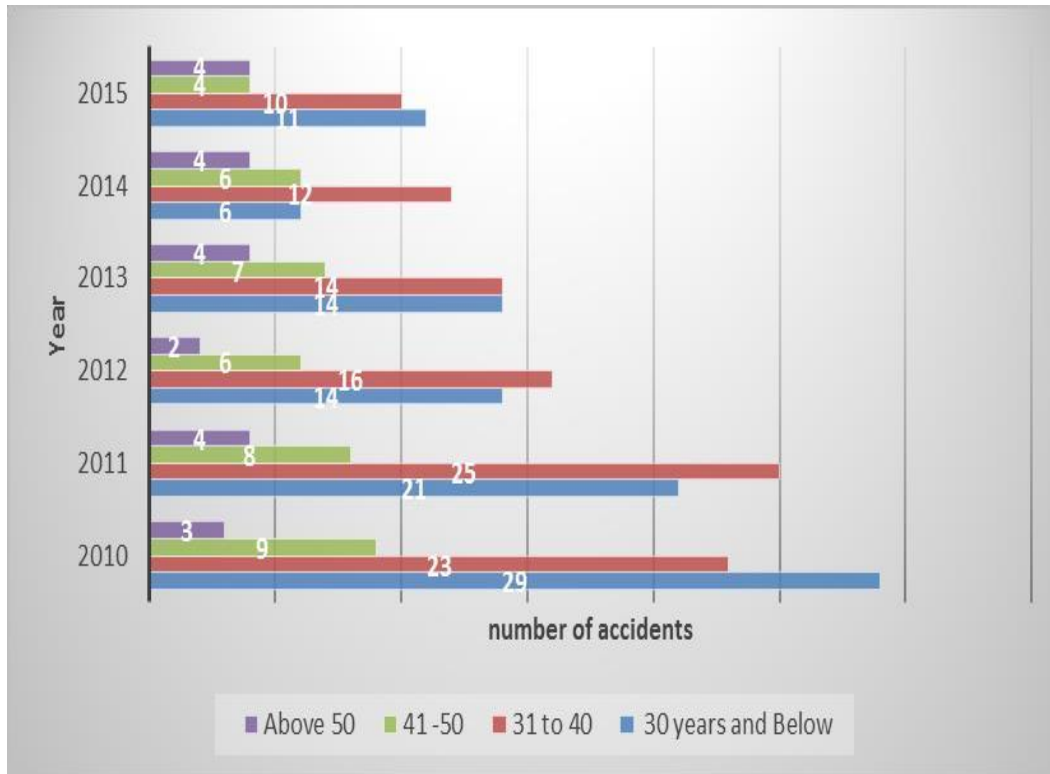


Figure 4.14: The trend of employees with different ages who were affected by accidents

Employees who were aged above 50 years between 2010 and 2015 were less involved in accidents as compared to employees who were aged 30 years and below. The results showed that those aged above 50 years had received more on

the job training and were familiar with tasks. With maturity, and knowledge of work risk taking was less.

4.14 Leading indicators: Issue based risk assessments activities.

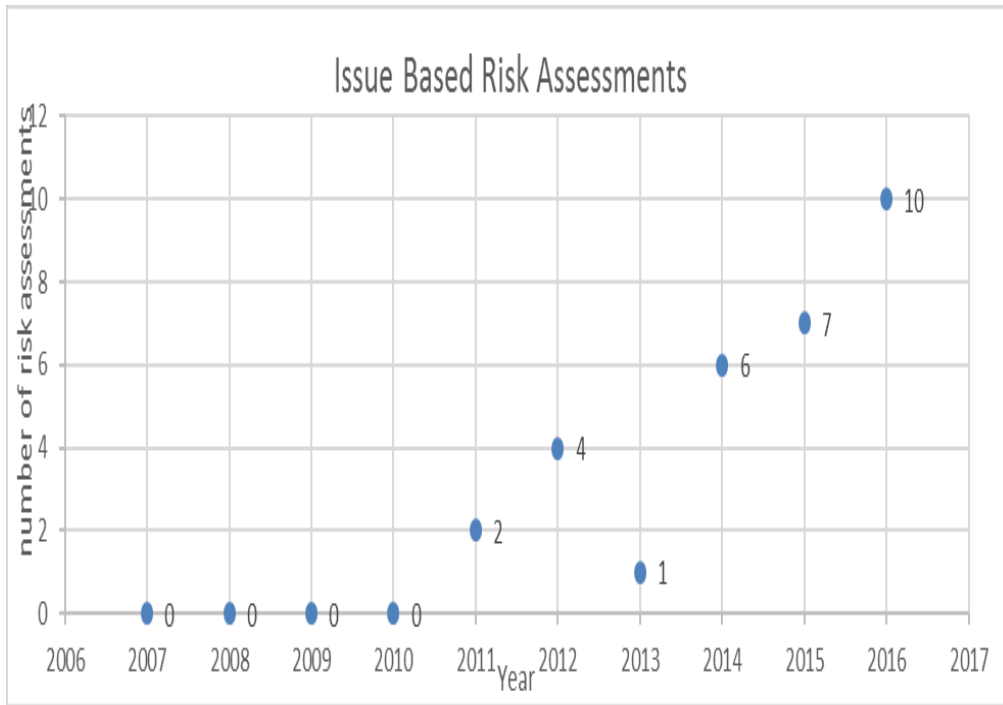


Figure 4.15 Issue based risk assessments

The issues of safety health came in many areas of operation, hence the naming which showed the diverse operations. Proactive action taken was recorded (leading indicators) after the adoption of OHSAS18001. A scatter graph was constructed from the primary data. From 2007 to 2010 there were no records of any issue based risk assessment. In 2011 there were 2 , 2012 there were 4 , 2013

there was one , 2014 there were 6 ,2015 they were 7 and 2016 there were 10. There was increased risk assessment activities from 2007 to 2016.

4.16. The relationship between number of accidents and issued based risk assessment

The following was a regression model on the relationship between number of accidents and issue based risk assessments.

Regression model at 95% confidence interval

Number of accidents = a + B (risk based assessment) + e

a = the alpha of the regression equation

B= is beta co efficient which measures how the percentage change in the independent variable would change the dependent variable

e = the regression error term which are the factors that affect the number of accidents that were not included in the equation because they were not quantifiable.

Table 10: Regression of number of accidents and risk assessments

P value	0.04
Coefficient	-4.46
R square	0.69

R square, which was the coefficient of determination, was found to be 0.69 which was a positive correlation ship. P was 0.04, and coefficient was -4.46. Variables

are considered not related when the coefficient the coefficient of determination is zero

The results of the regression indicated a negative relationship between number of accidents and issue based risk assessments. Increased risk assessment resulted in decreased accidents. Findings from compensation claims and clinic injuries confirmed the regression model. The findings postulated that percentage increased in issue based risk assessment resulted in decreased in number of accidents by 4.46%. This meant that as risk based assessments were carried out, the number of accidents reduced because the potential danger was prevented.

4.17 Safety performance regression model

Safety performance = a +B1 (Training, awareness and competence trainings) + b2 (communication, participation and consultation of personnel) +e

Table 11

P Value	0.0346
coefficient	0.483
r square	0.571

The p value was lower than 0.0346 which showed it was statistically significant

The r square of 0.6 showed that there was a positive relationship among the variables, training, awareness, and competence training as well as communication, participation and consultation. Increased activities in the variables showed a positive improvement in safety performance.

The findings were in line with a study by Sadus and Griffith (2004), who pointed out that where personnel were able to identify hazards and risk as a result of training, consultation, communication and participation, risks were reduced significantly.

4.18 Discussion of results

Trends of accidents

The Study revealed that accidents declined from 2007 to 2016. The number of accidents declined by 90% from 2007 to 2016. Findings of the study agreed with assertions made in the study by Cox (1996) who pointed out that safety was a result of people and their interaction with systems in place. The changes were articulated by the study had undulations. However Robson *et al.* (2007) argued that there was no sufficient evidence to show OHSAS18001 improved safety performance. In the study at How mine evidence was shown through total accidents, and checking workers compensation records which were administered by National Social Security Authority who are independent from mine operations. Evidence shown from data sources from different sources pointed to declined total number of accidents. The findings of the study agreed with that of

Fernandez- Muniz (2009) who pointed out that the number of accidents and injury severity rate decreased in organizations who adopted OHSAS 18001.

Injury frequency and severity rate

The correlation between injury frequency rate and injury severity was 0.97 which indicated a positive relationship between injury severity and injury frequency rate. As the injury frequency rate increased, the injury severity also increased.

The results concurred with a study by Gallagher (2000) who postulated that the rate of injury decreased in organisations who adopted OHSAS18001 as the injury frequency decreased.

Calculation of the severity rate using lost time and exposure time gave a true reflection. Conclusions were made based on the computations which showed a reduction.

The injury frequency rate dropped to 0.3 and injury severity rate dropped to 0.1. According to the International Labour Organization when the injury frequency rate and injury severity rate are below 1 the workplace was considered safe. The study revealed the transition which occurred at How mine which could be attributed to OHSAS18001.

Lost time and, non-lost time injuries.

Lost time and non-lost time injuries were discussed to show proof of changes brought by OHSAS18001. The study found out that there was a general decrease of lost time accidents from 2007 to 2016. OHSAS was adopted in 2011. The average injuries in 4 years before adoption was 56 and the average injuries in 4 years after adoption was 35. The results showed a decreased injuries at the entire mine by 36%.

Safety practices

Safety practice being a social construct was measured through seeking opinions of personnel at the mine. Results of the study showed that 65% agreed that safety practices changed and 30% disagreed. The results of the study on the opinions of the employees showed a relationship where more than 50% agreed there was changed in safety practices. Differences in views were postulated by Vechio-Sadus and Griffith (2004) who argued that more years were needed to objectively evaluate a system. In the study five years of system adoption was long enough to show effectiveness. The setting of the one years of service was aimed at obtaining balance opinions from the respondents. The findings were supported by the study of De Oliveira et al (2013), who pointed out that personnel opinions were

essential when assessing safety practices, even though they do not have a metric measure which can be proved.

Number of accidents and issue based risk assessments.

The adoption of OHSAS 18001 brought in the proactive approaches. Risk based assessments and planned task observations increased. The study analysed results using the regression model given in findings. The p value was found to be 0.04 which showed that there was statistical significance since it was less than 0.05. The results indicated that issue based risk assessment were a significant explanatory variable on the number of accidents at How mine.

The correlation between issue based risk assessment and number of accidents was negative (-4.46) as from the regression equation. As issue based risk assessment increased number of accidents decreased by 4.46%. The regression model concurred with the accidents statistics records which showed that as the issue based risk assessments increased the number of accidents decreased. A study by Dalrympel *et al* (1998) pointed out that use of OHSMS resulted in reducing injuries in high income countries. The findings of Dalrympel *et al.* 1998 concurred with the results of the study, carried out at How mine in Zimbabwe. A study by Kenndy and Kirwan (1998) asserted that effective safety management depended on management practices. The adoption of the OHSAS 18001 improved safety performance at How mine.

Hypothesis

Results of the study rejected the null hypothesis and accepted the alternative hypothesis.

4.20: Summary

The chapter covered data analysis of the overall findings obtained from questionnaires and interviews. Cross tabulation were used to present the findings. Logical conclusions and interpretation of results were arrived at using statistical analysis. The next chapter will deal with summary, conclusion and recommendations.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction.

This chapter was concerned with the highlights of the study from chapter one to chapter four. The major findings were summarized and conclusions are made in relation to the research questions, which were investigated. The information obtained enabled the researcher to make conclusions and recommendations on the research undertaken.

5.1 Summary of findings

The research findings were summarized and presented under the respective research objectives of this study, as follows:

5.1.1: The occupational accidents trend before and after the adoption of occupational health and safety assessment series 18001

The study revealed that the period between 2007 and 2016 showed declined accidents, by 90%. This suggested there was a positive impact brought about by the adoption of OHSAS 18001. Three fatalities were last recorded in 2008 and

there had been no fatality up to 2016. OHSAS 18001 influenced safety performance.

The finding concurred with a study by Fernandez –Muinz *et al.* (2009) who pointed out that organizations who adopted OHSAS18001 experienced low injury severity rates and had improved safety performance. On the contrary a study by Eisner and Leger (1998) argued that systems approach did not bring significant lowering of injury severity rates results in South Africa mines. The study also revealed that the more experienced workers were less affected by accidents compared to the less experienced workers.

5.1.2: Lost time injury and non-lost time injury

The study revealed that non lost time injuries were more than the lost time injuries. The problem of accidents at the mine was still a cause of concern. Accident causation theories by Frank Bird (1974) pointed out that the minor accidents eventually resulted in major accidents. Finding were supported by the domino theory which pointed out that management control had to be improved to reduce non-lost time injuries.. The adoption of the OHSAS18001 approach showed decreased major lost time accidents but non-lost time accidents were high.

5.1.3: Injury severity rate and frequency rate

The study revealed that the injury severity rate and injury frequency rate declined from 2007 to 2016. The injury frequency rate reduced from 12 in 2007 to 0.3 in 2016. The injury severity rate reduced from 11 in 2007 to 0.1 in 2016. Using the ILO rating standard How mine was transformed to a safe work place status where injury severity and injury frequency rate are below 1. However there organization must not be complacent. The study also revealed that there was a positive relationship between injury severity rate and the number of lost time accidents. The period 2007 to 2016 realized decreased in injury severity rate as most accidents were minor injuries with no time lost. The study also indicated the safety performance changed in the positive direction with compensation claims being for minor injuries.

5.1.4: Safety practices before and after the adoption of the management system

The study revealed that How Mine experienced changed safety practices during the period reviewed. Avoidance of fatalities from 2009 to 2016 alluded to significant changed safety practices. Safety and health matters were given top

priority in all the operations. Communication, and consultation and risk identification activities increased after the adoption of OHSAS18001. The study also revealed that safety and health training, communication, participation and consultation were positively related to management commitment to safety performance. Increased in training, and consultation activities for all employees provided a platform for suggestions from all employees.

5.2: Conclusion

Low injury severity rates was observed at How mine. The findings concurred with a study by Bottani (2009) who pointed out that in organizations who implemented OHSAS 18001 had low severity rate. Accidents a reduced from 2007 to 2016. The high number of minor accidents revealed that behavioural changes of all employees was not at anticipated levels.

The study showed that there was improved safety performance as evaluated by the low injury severity rate and low compensation claims. OHSAS 18001 brought great improvements at How mine.

The results showed that OHSAS18001 influenced safety performance at How mine..The results rejected the null hypothesis and accepted the alternative hypothesis.

5.3: Recommendations

1. Management at How mine need to continually influence the change of human factors to achieve improved safety performance. The occurrence of accidents had not reached satisfactory levels as non-lost work accidents were still high. OHSAS 18001 focused on procedures, incident reporting and preparations for audits.
2. Safety leadership by line supervisors at all levels need to be strengthened to achieve total monitoring and regulatory compliance.
3. How mine management need to introduce behaviour based safety programs to model employees' attitudes and practices to reinforce the OHSAS 18001 system.
4. Management at How mine to consider application of effective employee motivation to improve perceptions, involvement and participation.
5. Operational controls of risk based assessments, stop work and correct need to be increased to enhance safety performance. The controlling of accidents through punishment of the affected employee should be very minimal.

6. To strengthen continual improvement initiative management at How mine need to recognize and reward employees and crews for pro-active safety actions and suggestions.
7. Management at how mine need to appoint teams to carry out ergonomic surveys at work station where employees were susceptible to injuries and musculoskeletal disorders.

5.4: Area of further study

In Zimbabwe further studies should be done on the effectiveness of OHSAS 18001 in manufacturing and other mining organization for comparison and generalization of the impact of systems approach to safety performance evaluation.

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APPENDICES

Appendix 1:

Questionnaire for How Mine employees.

My name is Lovemore Mpfu and studying at Midlands State University for a Master of Science in Safety, Health and Environment Management degree. The purpose of this questionnaire is to gather information that will assist in a research entitled “**An assessment of Occupational Safety and Health Management System OHSAS18001 on safety and Health performance at How Mine**”. The study aims to evaluate whether the adoption of the OHSAS 18001 brought any impact on safety and Health performance at How Mine.

The results are for academic purposes only and will not prejudice anyone who takes part in the survey. Thank you very much for taking part in this important survey.

Completion of the questionnaire is voluntary, anonymous and confidential. Be assured that all answers you provide will be kept in confidentiality.

Guide to responding to the questionnaire

Please do not write your name to ensure you remain anonymous

Your responses will be treated with confidentiality

Complete the questions by ticking your preferred response in the box or space provided.

SECTION A: PERSONAL DATA

1. Department:

2. Contractor Employee

3. Gender: Male Female

4. Age: 20 years and below 21-35 36- 49 50 years and above

5. Work Experience 5 Years 6-10 Years 10+ Years

6. Level of Education 'O' level 'A' Level Diploma Degree

7. Rate the safety and health practices on scale 1-5 before OSHAS 18001, tick your score

	Strongly agree 5	Agree 4	Uncertain 3	Disagree 2	Strongly disagree 1
No cares about safety and Health at the organization					
Action taken when there is an accident					
There are systems in place to manage all hazards and risk					
We try to anticipate					

problems before they occur					
Health and safety is our way of doing business, audits, incident reporting, training					

8. Rate the safety and health practices on scale 1-5 after OSHAS 18001, tick your score

	Strongly agree 5	Agree 4	Uncertain 3	Disagree 2	Strongly disagree 1
No cares about safety and Health at the organization					
Action taken when there is an accident					
There are systems in place to manage all hazards and risk					
We try to anticipate problems before they occur					
Health and safety is our way of doing business, audits, incident reporting, training					

Give your opinion rate the following questions on the scale 1-5

9. Before adoption of OHSAS 18001 rate the following by ticking on the score given below :

	Strongly agree 5	Agree 4	Uncertain 3	Disagree 2	Strongly disagree 1
Management committed to safety and Health performance					
Hazard identification and risk control involved personnel from various departments					
Safety and Health trainings were conducted regularly and adequate					
Communication ,participation and consultation on safety and health matterextended to all personnel					
Safety and Health					

performance considered seriously as production					
Departments carry own internal audits and meetings done with all personnel to address deviations					
Safety and health inspections/audits are for few specialized personnel					
Checking and corrective action on safety and health issues done quickly and timeously					
Management responded quickly and timeously to production needs					
Management give review of safety performance and production regularly					
Management and employee behavior has not changed					
Safety and Health culture has changed over the past years					

10. What safety and health activities or practices are in place to curb accidents and mishaps.....
.....

11. Is there any improvement or deterioration in the work environment,

Specify

.....

Thank you very much for your cooperation
ZERO HARM IS POSSIBLE

Appendix11

12. After adoption of OHSAS 18001 management system rate the following by ticking on the score given below

	Strongly agree 5	Agree 4	Uncertain 3	Disagree 2	Strongly disagree 1
Management committed to safety and Health performance					
Hazard identification and risk control involved personnel from various departments					
Safety and Health trainings were conducted regularly and adequate					
Communication ,participation and consultation on safety and health matters extended to all personnel					
Safety and Health performance					

considered seriously as production					
Departments carry own internal audits and meetings done with all personnel to address deviations					
Management responded quickly to production needs					
Checking and corrective action on safety and health issues done timeously					
Management give review of safety performance and production regularly					
Management and employee behavior has not changed					
Safety and Health inspections/audits a function of few specialized personnel					

13. What safety and health activities or practices are in place to curb accidents and mishaps.....
.....

14. Is there any improvement or deterioration in the work environment,
Specify
.....

15. Rate the Safety and Health Practices on scale 1-5 before OSHAS 18001, tick your score

	Very Satisfactory 5	Satisfactory	Uncertain 3	Not Satisfactory 2	Very Unsatisfactory 1
Pre Task assessment					
Written and practiced work procedures					
Employee involvement					
Safety and Health Training					
Communication and information sharing					
Accident /Incident investigation					

16. Rate the Safety and Health Practices on scale 1-5 after OSHAS 18001, tick your score

	Very Satisfactory 5	Satisfactory	Uncertain 3	Not Satisfactory 2	Very Unsatisfactory 1
Pre Task assessment					
Written and practiced work procedures					
Employee involvement					
Safety and Health Training					
Communication and information sharing					
Accident /Incident investigation					

**Appendix 111:
Interview guide for Line Managers**

This interview is designed for collection of information on any impact of the systems approach to improve safety and health performance. The information you avail is confidential and will be used for academic purposes only.

Interviewer's name:

1. Describe employee competence, knowledge and skill before and after the systems approach.
2. Have you made any attempts to educate employees about near miss reporting? If yes, what was the response, and have you noticed any change?
3. What takes precedence in your operations as production and safety are two sides of the same coin?
4. Do you think the systems/initiatives encourage employees to freely report all their operational needs?
5. What do you think should be done to balance production demands and safety performance in your department/section?

Thank you for your cooperation

Appendix 1V

Interview guide for SHEQ Manager and Health services Manager

This interview is designed for collection of information with regards to occupational injury rates for the period under review. The information you avail is confidential and will be used for academic purposes only.

Interviewer's name:

1. What is the trend of accidents and occupational from 2006 to 2016?
2. What is the margin of change if any?
3. What measures or initiatives have been in place before and after adoption of OHSAS 18001 system to prevent accidents and diseases?
4. Who is responsible for hazard identification and risk assessment
5. What indicators did you use to measure safety performance before OHSAS18001?
6. What indicators are you using to measure safety performance currently?
7. What efforts/measures have you put in place to involve managers' employees in embracing the systems approach?
8. Was there any systems education program/campaign conducted in your section/s? If yes, what was the response, and have you noticed any change?
9. Are you receiving adequate support from line management in terms of achieving best safety and Health performance?

10. What do you think should be done to improve the level of compliance to the system requirements?

Thank you for your cooperation

Appendix V

Interview guide with the General Manager

This interview is designed for collection of information with regards to management review and continual improvement at the entire mine. The information you avail will be treated with strict confidence and is for the purposes of this research only.

Interviewer's name:

1. What is entailed in your management reviews and how often are they held?
2. What are your strategies for participation, communication and training to improve safety performance and production
3. What is your analysis of occupational accidents and diseases as well as production for the past 11 years
4. How is continual improvement integrated into the business functions
5. Comment on the traditional approach and systems approach as far as safety and Health performance and production is concerned.

Thank you very much for your cooperation

ZERO HARM IS POSSIBLE

16 September 2016

The Human Resources Manager

How mine

P.O.Box 2259

Bulawayo

Dear Sir

Subject: Request to conduct an Industrial based Academic research

I hereby request permission to carry out an academic research at How Mine. I am a student at Midlands State University studying Master of Science in Safety Health and Environment.

As an academic research the study would contribute to the scientific knowledge of managing occupational safety and health risks at work places. The University require proof of permission to carry out the research.

In light of the above the researcher is asking your kind office to permit him to carry out the study.

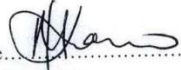
Researcher



Lovemore Mpofu

Authorising Authority: How mine

Name..... M. Nkomo

Signature..... 

Date..... 16.09.16

HUMAN RESOURCES MANAGER
P.O. BOX 2259 HOWMINE
CELL 0772 126 880-3
DATE: 16.09.16

Determination of sample size

In the study the researcher calculated sample size using Cochran (1977) method and outlined by Barlett et al (2001). In Cochran formula the alpha level utilizes the t- value in a normal distribution.

The following were chosen in the research:

The alpha level at 5% this is the risk the researcher took in this study which is in line universally with range for surveys (Saunders et al 2009)

1. The alpha level at 5% is the risk the researcher took this is in line with the universally accepted norm for surveys.
2. The sampling error in the study was at 3% as the study used continuous data as suggested by Krejcie and Morgan (1970).
3. The variance or standard deviation $S =$ number of points on scale divided by number of standard deviations, therefore

$$S = \frac{5 \text{ (number of points on the questionnaire)}}{6 \text{ (number of standard deviations)}} = 0.8333;$$

The six deviations (three on each side of the mean) would capture 98% Of the responses.

Minimum sample size n_0

$$\begin{aligned}n_0 &= \frac{(t)^2 \times (s)^2}{(d)^2} \\&= \frac{(1.96)^2 \times (0.8333)^2}{(5 \times 0.03)^2} \\&= 118.5 \\&= 119\end{aligned}$$

Where:-

t = value for selected alpha level of .025 in each tail = 1.96

s = estimate of standard deviation in the population = 0.8333 (estimate of variance deviation for 5 point scale calculated as shown above.

d = the acceptable margin of error for the mean, being estimated = 0.15 (5x0.03)

The estimate sample size for 632 is 119 if does it not exceed 5% of the population. The estimated sample exceeds 5% of the population ((632x0.05 = 32). Hence Cochran (1977) correction formula had to be applied to calculate the final sample size.

Therefore the final sample size n was calculated as follows:

$$n = \frac{n_0}{1 + (n_0 / \text{Population})}$$

$$\begin{aligned}
 &= \frac{119}{1 + (119 / 632)} \\
 &= 100.14 \\
 &= 100
 \end{aligned}$$

Comparing the computed population to the one tabulated by Bartlett, Kotrlik and Higgins (2001) the sample size chosen is relevant to the population at How mine.

Table 4: Table for determining minimum returned sample size for a given population size for continuous data.

Population size	Sample size Margin of error=0.03; alpha = 0.05; t=1.96	Population size	Sample size Margin of error=0.03; alpha = 0.05; t=1.96
100	55	900	105
200	75	1000	106
300	85	1500	110
400	92	2000	112
500	96	4000	119
600	100	6000	119
700	102	8000	119
800	104	10,000	119

Source: Adopted from table developed by *Bartlett, Kotrlik and Higgins (2001)*