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CRITICAL EVALUATION OF THE CONTRACTORS' OCCUPATIONAL SAFETY AND HEALTH (OSH) MANAGEMENT SYSTEMS IN THE PREVENTION OF OCCUPATIONAL ACCIDENTS AT ZIMPLATS, SELOUS.

DISSERTATION SUBMITTED

BY

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A dissertation submitted to the department of Geography and Environmental Studies of the Midlands State University in partial fulfilment of the requirements of the Master of Science in Safety Health and Environment Management degree.

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Dedication

This project is dedicated to my sons Tinotendaishe and Nasya for their unwavering inspiration in my pursuit of success.

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ACRONYMS

ALARP – As Low as Reasonably Practicable.

BBS – Behaviour Based Safety.

ILO – International Labour Organization.

HSE – Health, Safety and Environment.

JHA – Job Hazard Analysis.

JGHSC – ArcelorMittal Joint Global Health and Safety Committee.

KPIs – Key Performance Indicators.

IRS – Impala Refining Services.

ISO – International Organization for Standardization.

MSDSs – Material Safety Data Sheets.

NSSA – National Social Security Authority.

OECD – Organisation for Economic Co-operation and Development.

OEM – Original Equipment Manufacturing.

OHSAS – Occupational Health and Safety Assessment Series.

OSH – Occupational Safety and Health.

PJO – Planned Job Observations.

Ppe –Personal Protective Equipment/Clothing.

PGMs – Platinum Group Metals.

SAZ – Standard Association of Zimbabwe.

SHEQ - Safety, Health, Environment and Quality.

SMC – Selous Metallurgical Complex.

SMS – Safety Management System.

SPSS – Statistical Package for Social Sciences.

USA – United States of America.

VFL – Visible Felt Leadership.

ABSTRACT

This study focused on the critical evaluation of contractors' occupational safety and health (OSH) in managing accidents at workplace at Zimplats, Selous. The objectives of the study were to analyse causes of accidents in contractors, to evaluate establishment of contractor OSH system, evaluate establishment of contractor OSH management system, determine efficacy of the OSH management system in accidents reduction and to analyse the safety culture of contractors.A cross sectional survey design was employed and a sample of 172 contractor employees was selected. Questionnaires and semi structured intervals were self-administered to solicit data from contractor employees and key informants respectively. Observations coupled with taking photographs and retrospective review of data complemented the collection of valid and reliable data regarding analysis of OSH management system of contractors. Statistical package for social science (SPSS) was used to analyse quantitative and qualitative data. The study revealed that OSH management system is not effective and there is no safety culture among contractors. Furthermore, the main causes of accidents are production pressure, unsafe acts, inadequate risk assessment and inexperienced labour force. Also top contractors' management is not visible and committed in safety and health programs to address issues coming from leading and lagging indicators. The study recommended the top management of contractors to accept full responsibility for safety and health and be role models. Furthermore, the principal company and contractors should harmonize safety systems through Job Hazard Analysis and on-site training to involve all part members. To relate production target to labour force so that production is direct proportional to a person per ton produced. Lastly but least the principal company to carry out periodic contractor assessment and auditing to keep contractors committed to the occupational management systems.

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Chapter 1

INTRODUCTION

Introduction

Contracting out of mining operations has increased significantly in the mining industry over the last two decades. Some contractors are used in mining to undertake specialized tasks in underground and above ground operations. Subcontracting of this variety provides for gains in specialization to the operator and in terms of economic efficiency more broadly. But contracting has also been used as a means of shifting liability for pension and health obligations of union mine operators to other entities; to lower the cost of civil penalties and to avoid other employment related costs. More generally, contracting can be a means of shifting legal liability to low capitalized entities as a means of reducing costs associated with potential lawsuits.

Furthermore, it is clear that contractors have become and will remain into the future an important part of the mining industry workforce. They have always been used for highly specialised activities and also high risk operations. There appears to be a general recognition amongst stakeholders that the growing use of contractors in the mining industry has implications for Occupational Safety and Health (OSH) that require attention. This view is supported by a growing body of international research on the Occupational Safety and Health (OHS) effects of contract labour, whether they are self-employed, contractor employees or labour hire workers. ILO (2012) revealed that contract workers are a vulnerable group and hence exposed to health and safety risks: low bargaining power, ignorance of legislation and high unemployment.

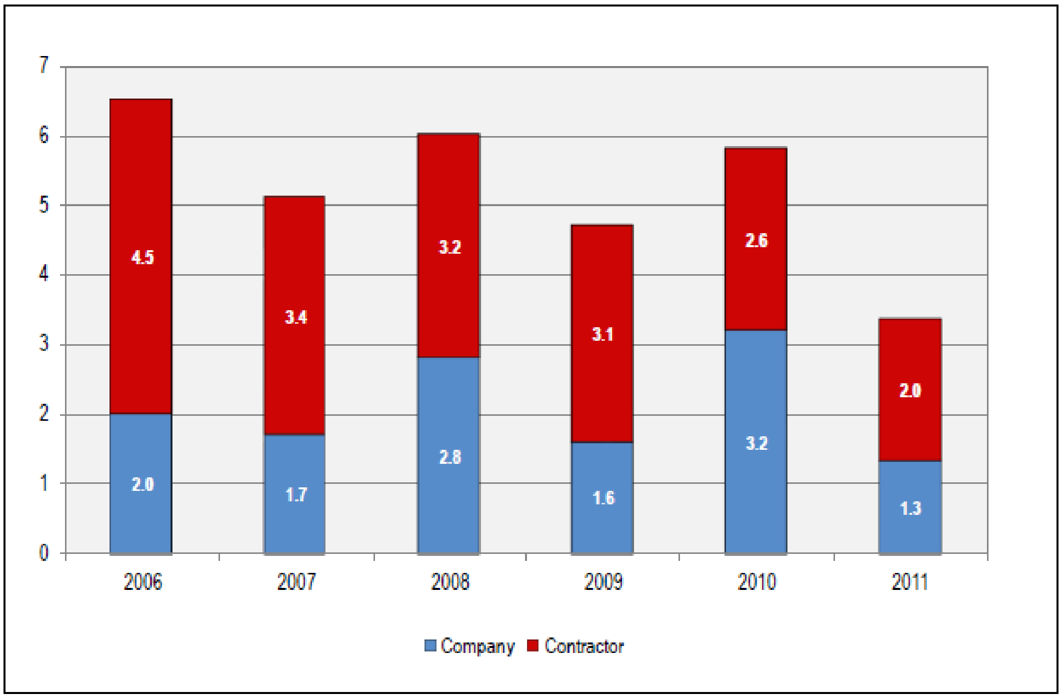
For example, in the United States of America (USA), a study by Rousseau and Libuser (1997) noted that contractor employees accounted for 17% of fatalities in the USA mining industry, even though they made up only 10% of the total mine workforce at that time. Furthermore, contract workers are exposed to risks beyond their control, contribute to risks because of lack of job-specific knowledge and experience in the diverse work they encounter.

According to Huabing (2006), subcontracted coal mines in China have killed a lot of people due to poor safety management and considering production first and disregarding safety. For example, on 14 February 2005 sections of the Sunjiawan mine in Liaoning province, where a gas explosion killed 214 miners. In additional, 21 contractors died Jinjiangpanhai coal mine due to gas explosion. Coal mine accident investigations point out that the mines lack the conditions to ensure safe production like basic ventilation system (Huabing, 2006).

Besides that, if the International labour organisation (ILO) estimates that 2 million workers die every year as a result of work-related accidents and in Zimbabwe over 200 people die every year as a result of work related accidents (Mutubuki, 2005). What this translates to is that one in every hundred thousand (1/100 000) of the world occupational fatalities is a Zimbabwean. Which means we are certainly world leaders but in the wrong race. Zimbabwe is certainly not one of those developed countries with a very small population, even smaller than that in cities in Europe, India or Asia yet it records so many deaths caused by occupational accidents.

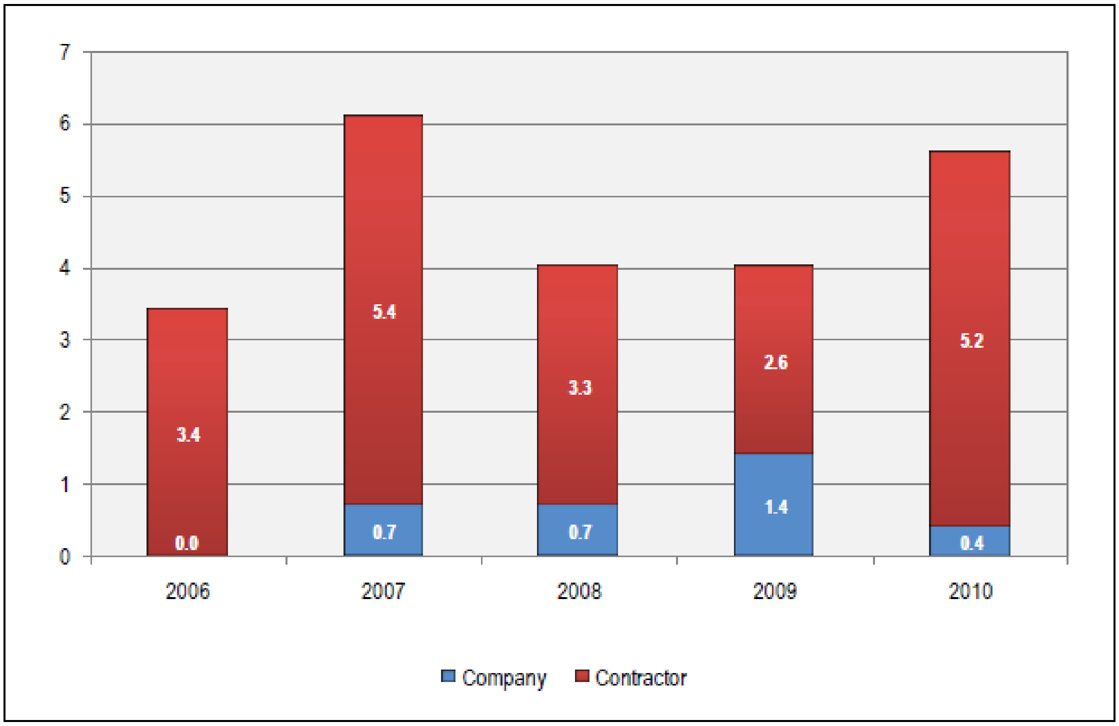
1.1 Background of study

According to Yemenu (2011) global industry trends indicate increased outsourcing of non-core business activities such as construction, maintenance and engineering to mention a few. He also highlighted that contractor face 1.5 to 3 times higher incident rates than employees of the outsourcing company. Indeed, it is acknowledged that the use of contractors can be associated with an increase in the adverse occupational health and safety outcomes (Quinlan and Mayhew, 2002). A good example is shown by figure 1.1 and 1.2 below which show that contract workers in both upstream and downstream oil industry in London and Brussels are more likely to face fatal accidents than employees (Burton, 2011).



Source: International Association of Oil and Gas Producers (OGP): *Safety performance indicators – 2011 data*, Report No. 2011s, May 2012 (London), pp. 1–3.

Figure 1.1: Fatality accident rates in the oil and gas exploration and production sector (per 100 million hours worked), 2006–11



Source: CONCAWE: *European downstream oil industry safety performance: Statistical summary of reported incidents*, yearly issue 2006–10 (Brussels).

Figure 1.2: Fatality accident rates in the European downstream oil and gas industry (per 100 million hours worked), 2006–10

Fatal accident rate between 2006 to 2009 was high in the upstream sector except 2010; this is just one time event as opposed all the years. According to these statistics on average, contract workers are about twice as likely to die at work as company employees, with more contract worker fatality accident rates in the downstream sector and higher rates offshore than on shore.

According to estimates by the ILO (2005) for occupational accidents and diseases, there are globally about 2.2 million work related deaths annually and fatal diseases are between 1.7 million deaths per year. The annual number of non-fatal work related diseases has been estimated to be 160 million and 58 million of these cause at least four days absence from work. Takala (1999) expressed that average fatal occupational accident rate is 14,0 per 100 000 workers and total fatal occupational accidents was 335 000.

Mining accounts for only about 1 per cent of the global workplace, but it is responsible for up to 5 per cent of fatal accidents at work (at least 15,000 per year, or 40 each day (ILO, 2003). No reliable data exist as far as injuries are concerned, but they are significant, as is the number of workers affected by occupational diseases (such as pneumoconiosis, hearing loss and the effects of vibration) whose premature disability and even death can be directly attributed to their workplace. Despite considerable efforts in many parts of the industry to improve its safety record, mining remains the most hazardous occupation in most countries where it exists when the number of people exposed to risk is taken into account. Ernst and Young (2011), also pointed out that it is estimated that worldwide mining disasters account for around 12 000 deaths.

According to Eijkemans (2004), in 2002, in Sub-Saharan Africa, ILO estimated that more than 257 000 total work related fatalities, including about 55 000 injuries were recorded. The South African Mining industry recorded in 2007 and 2008, 220 and 171 fatalities respectively while injuries accounted for 3 974 for 2007 and 3763 for 2008 (Department of Mineral Resources, 2009).

According to NSSA records of 2011, rate for mining industry from 2004 to 2009 is 1094, 959, 663, 550, 351 and 269 respectively. These are just the lost time injuries which indicate that if medical treatment cases, restricted work cases and fatalities this numbers will grow bitter than expected. The national average lost time injury frequency rate from 2004 to 2009 is 5.6 which is far much higher than the international and national requirements of <1. The average of injury frequency rate at Zimplats from 2009 to 2012 is 2.4 which is also on the higher side. This indicate a high rate of accidents which warrant to be investigated and make sure the shareholders enjoy the benefits of investing money in safety management system and also make sure that every employee enjoys a hazard free workplace.

1.2 Problem statement

Zimplats embarked and adopted the OHSAS 18001 and Behaviour Based Safety to manage occupational accidents in 2008 and 2012 respectively. Furthermore, given the experience the company has gone through when implementing the system it should have been mature and a downward trend of incidents must have been observed. According to Zimplats report of May 2013 a total of 10 lost time injuries were recorded and 60% of them were contributed by contractors and 40% Zimplats employees.

Besides that, at risk behaviour/unsafe behaviour are high in contractors. Through random alcohol testing at the main mine gate 90% of contractors are caught to be under the influence of alcohol whilst the company is an alcohol free area. This is the serious bleach of statutory instrument 109 of 1990 which states that no one is allowed to enter the mine premise under the influence of alcohol. In additional the peer to peer statistics indicate that 86% of contractors work without adequate protective clothing, failure to adhere to required protective clothing for the task/job, failure to carry out a pre-task risk assessment, failure to identify risks associated with their task and working without a work permit. These performance indicators measure the direct and indirect precursors to harm, and give advance warning before an event occurs that might lead to an undesired outcome, providing an opportunity for preventative action to be taken.

Apart from that, there is an increase in the number of projects and number of contractors on site this is a risk own its own because new, inexperienced general labourers and technicians take up high risk jobs. A good example of projects coming on line are Portal 5 at Mining side and Base Metal Refinery on Processing side which is going to employ hundreds of contractors doing different services all together. As new projects are coming in the risk exposure also increases. There is a total number of 4 243 employees for both mining and processing division and 2 145 are permanent employees and the rest are contractors.

There was no comprehensive study at the time that had been carried out to evaluate contractor management in platinum industry. So, this is an area in which our ignorance exceeds our knowledge therefore warrants academic research.

1.3 Objectives

1.3.1 General Objectives

The aim of the study is to analyse the establishment and effectiveness of contractors' OSH management system in accidents prevention and come up with a sound way to improve contractors' safety.

1.3.2 Specific objectives

1) To analyse causes of accidents in contractors.
2) To evaluate establishment of contractor OSH management system.
3) To determine efficacy of the OSH management system in accidents reduction.
4) To analyse the safety culture of contractors.

1.4 Justification of the study

According to Mutetwa (2012), Zimbabwe has recently gone through serious economic challenges, especially from period 2000 – 2008. In particular 2007 and 2008 saw almost critical staff leaving the country. Inexperienced workers are the ones manning the production. This supported by Dr Moyo (2010), that Zimbabwe has not been an exception and the current era of economic challenges has meant that companies focus more intently on the bottom line. This is a wearisome scenario because subcontracted artisans and general labourers are inexperienced or still green, as the experience have left to greener pastures in South Africa and Europe. Furthermore, Buy Zimbabwe campaign has brought in new and inexperienced service provider into the system. According to Zimbabwe National Trade Policy Document (2012-2016, pages 24-25) the local companies and Government will also endeavour to give priority to local producers of goods and services for its procurement requirements. So, players' especially engineering companies have flourished and are being engaged in critical operations of the plant. In additional, the artisan and engineers are still green and just coming from college. This means a new hazard has being introduced into the system and the company does not have any recognisable international or local standard to manage safety. A good example is that at Zimplats tools have caused quite number of incidents which points out that the contractors are still green in tool handling techniques. Non competent workforces bring in changes in the risk profile thereby impacting negatively on the company safety management system. Zimplats have identified contract management as a risk because of numeracy incidents/accidents. The Figure 1.3 below illustrates the safety risk at Zimplats.

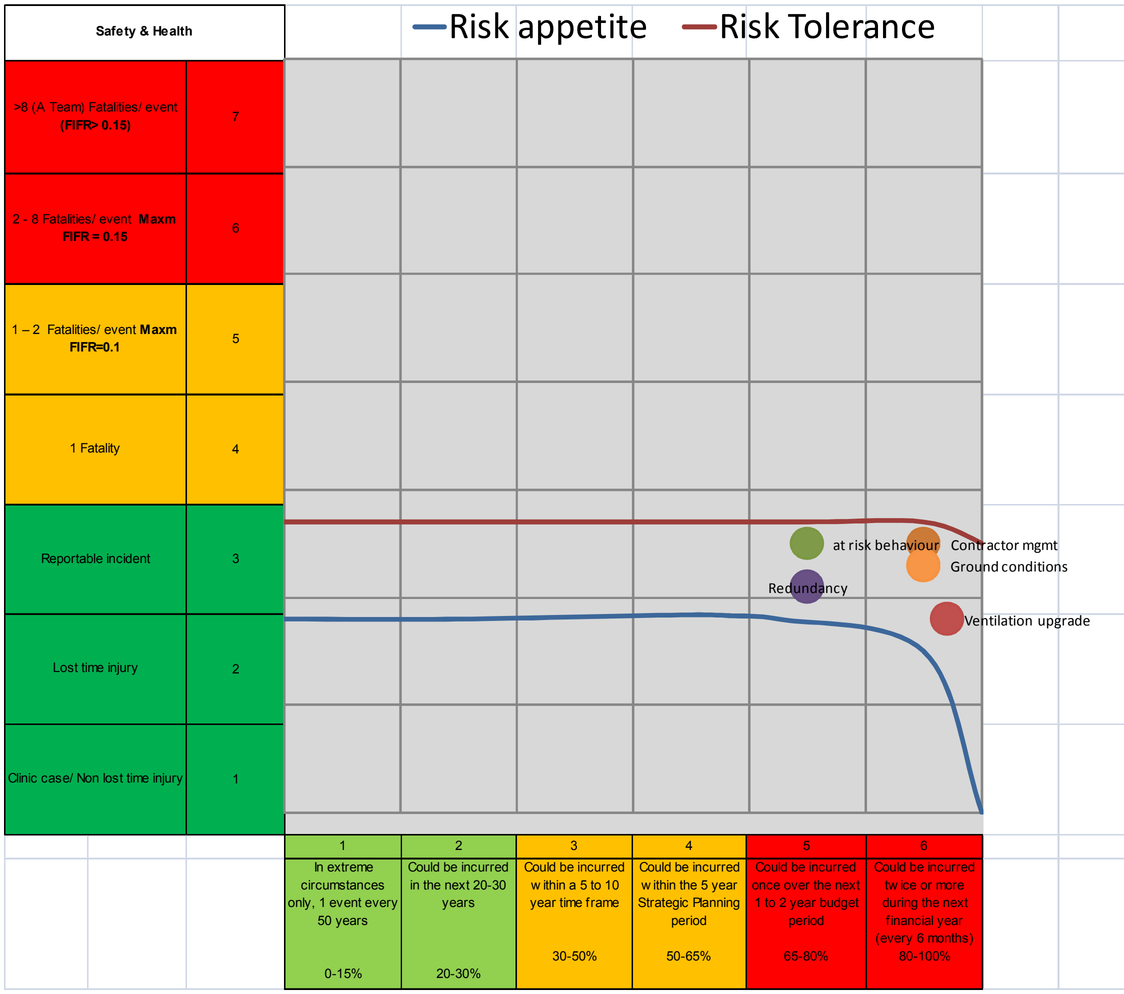


Figure 1.3: Zimplats risk assessment Source: Zimplats Annual Report presentation 2013

Figure 1.3 above illustrates the amount and type of risk that an organisation is prepared to pursue, retain or take. This brings out the concept of risk appetite. The risk appetite is concerned with both the kinds of risk (pre risk treatment) the organisation prefers as well as the level to which it wants to expose itself. Indeed, for many organisations, some of the largest risks they face relate directly to their major sources of income and taking these risks underpins their business model. This is logical, generally applicable and aligns with our normal understanding that our appetite is about what we like or don't like and how much we require or desire. So, this risk of contractor management is within the Zimplats appetite meaning they have acknowledges a willingness and capacity to take on risk.

Besides that, Zimplats implemented OSH management system (OHSAS 18001) in 2008 and it has reached its maturity stage. The OHSAS 18001 standard also mentions contractor safety, requiring the corporation to ensure that the organisation’s safety and health requirements are applied to contractors. High rate of lagging and leading indicators points to the failure of contractor safety as per system requirement. The effectiveness of the system is seen in reduction of accidents and flourishing of safe behaviours or good practise. This also brings out the concept of safety culture. This is a way in which safety is managed in the workplace, and often reflects "the attitudes, beliefs, perceptions and values that employees share in relation to safety" (Cox and Cox, 2007). . In other words, the safety culture of an organization acts as a guide as to how employees will behave in the workplace. Of course their behaviour will be influenced or determined by what behaviours are rewarded and acceptable within the workplace. Safety culture is essential for sustenance of a good safety performance. This is the ultimatum of a BBS initiative. When safety culture is fully embedded incident or accident reduction is eminent (Tony A. M. 2006). According DuPont Solutions (2013), in a mature safety culture, safety is truly sustainable, with injury rates approaching zero. People feel empowered to take action as needed to work safely. They support and challenge each other. Decisions are made at the appropriate level and people live by those decisions. The organization, as a whole, realizes significant business benefits in higher quality, greater productivity, and increased profits. The incoming of contractors has brought in a different safety culture. Another point to note is contractors came with a reputation for flaunting safety and also for being under-equipped. The expansion of Zimplats was punctuated by contract labour and contracting companies whose safety philosophy is unknown and cannot be fused with the parent company.

1.5 Study Area.

1.5.1 The Location

Zimbabwe Platinum Mines Limited (Zimplats) is in Chegutu District of Mashonaland West Province, 9km North of Selous which is 80km South West of Harare on the Makwiro road. Map 1 below shows the location. The area is used almost entirely for crop and livestock farming. A public road known as Makwiro road crosses the site, and the National road from Harare to Bulawayo crosses the south-east corner. Part of the village of Selous encroaches into the south-east corner. Crop farming occupies a minor proportion of less than 8% of the total area and the majority area of about 90% is for cattle farming.

The majority of the site is underlain by gabronorite but, along the western boundary, is the pyroxenite outcrop, flanked by minor occurrences of serpentinite. There is a minor area of granite in the south-west corner. The soils are derived from the parent rock. The majority of the soils are well drained reddish-brown sandy clays, poorly drained black or dark grey heavy clays, or associations of the two. Besides that the vegetation is mainly on gabronorite which consist of several types of brachystegia woodland, or open grassland with scattered acacia species.

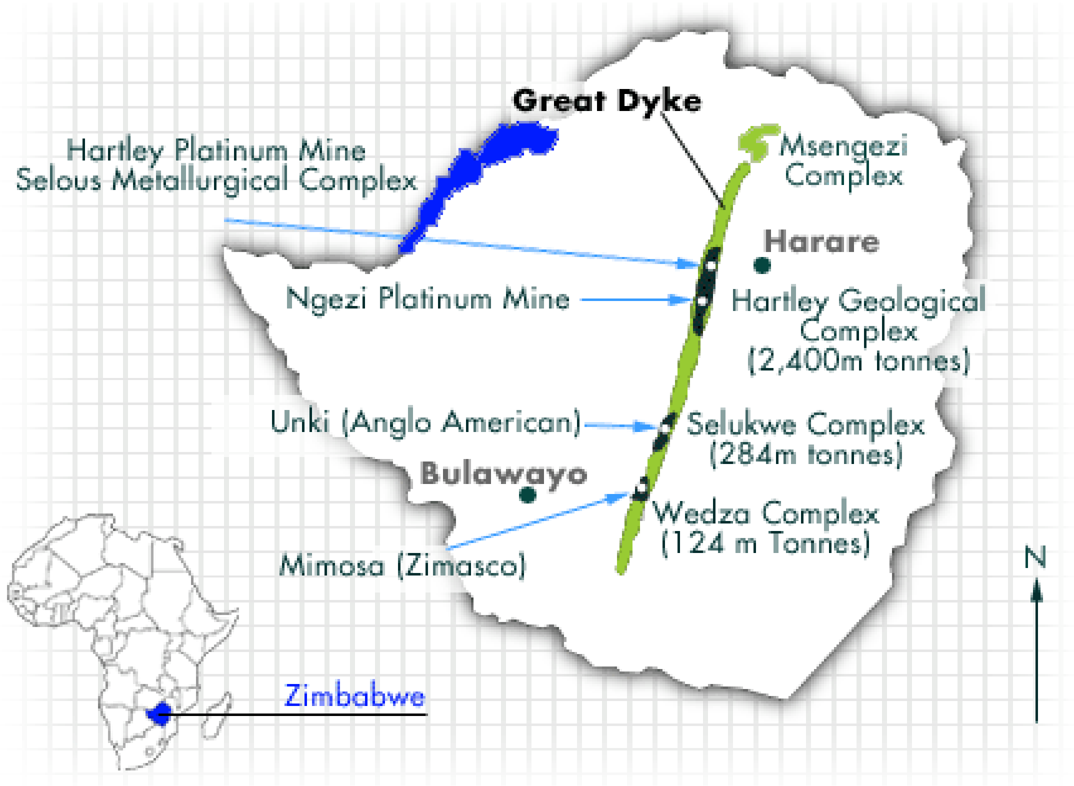


Figure1.4: Location of Zimplats.

1.5.2 Nature of Operations

Zimbabwe Platinum Mines (Pvt) Ltd ("Zimplats") Zimplats mines a platinum-rich ore body in the Ngezi area, 70 - 80 km south of Selous. Mined ore is transported by road trains either to the brand new Ngezi concentrator, some 10 km north of the mining operation or to the Selous Metallurgical Complex (SMC) which lies near the town of Selous.

Concentrating is now carried out in near equal proportions at the Ngezi and Selous concentrators. The concentrator comprises three main sections, Ore Receiving, Milling and Flotation. Liberation of the PGMs and base metal host minerals from the rock matrix is achieved by communition in a two stage closed circuit grinding section followed by recovery and upgrading of the mineral concentrate by flotation. The final flotation concentrate is pumped to the smelter section for further processing.

Concentrate from the Ngezi concentrator is transported north to the Selous smelter, where it joins material from the Selous concentrator to be smelted. The Selous smelter is located alongside the Selous concentrator and comprises a single furnace with two converters. This is used to produce smelter concentrate which is trucked to Impala Refining Services (IRS) in Springs, east of Johannesburg, South Africa, for final refining of base and precious platinum group metals.

Mining at Ngezi was formerly from an open pit operation, but operations at the open pit were suspended in October 2008. Currently, ore is sourced from shallow workings (c. 70m below surface) accessed by 3 twin decline systems, and from a stockpile at the currently suspended open pit section. All mining is by mechanised room and pillar methods. According to Zimplats, Our Business (2012), Zimplats has compliment of around 3000 permanent employees and 1500 contractors. It has the following annual metal production:

Platinum – 270 000 ounces

Palladium –217 500 ounces

Gold – 30 000 ounces

Rhodium – 24 000 ounces

Nickel – 4 650 tonnes

Copper - 3 300 tonnes

Plus 4 other metals – Ruthenium, Iridium, cobalt and silver.

Platinum group metals ("PGMs") are rare precious metals, which frequently occur together in nature as constituents of various ores and minerals. PGMs are a family of six metals:

platinum, palladium, rhodium, iridium, ruthenium, and osmium, all of which have similar chemical and physical properties and are grouped together in the periodic table.

PGMs are regarded as strategic industrial metals because of their extensive use in the petrochemical, automotive and electronic industries. In many applications, it is impossible to substitute PGMs economically and technically.

Socio-economically, there are resettlement areas in the vicinity which include Manyoni, Jondale -Bumbe, Ngezi 2 and Ngezi National Park. In both communal and resettlement areas, crop production is the major economic activity. Subsistence agriculture is widely practised and land is regarded as a source of money and livelihood with maize as the predominant crop in the area. Platinum mining and small scale Chromite mining have brought economic dynamism in the area and this has helped the area to have a new outlook as most unskilled locals have benefited from employment creation.

1.6 Limitations of the study

The study incurred challenges with approaching these contractors because of the economic climate. The researcher was treated with suspicion even after clarifying purpose of the research. The sample population was attained but this could have compromised the depth of information that could have been gathered as some of the respondents who reserved their comments because they were afraid of losing business because of their poor safety record.

Chapter 2

Literature review

2.0 Introduction

Several other authors have looked at the impacts of temporary work on safety (François and Lievin, 2000; Morris, 1999). They have observed a higher risk of accidents for workers on fixed term contracts and temporary work. Whatever form the new contractual relationships take, the expert group agreed that the determinant element having an impact on safety is the precarious character of the employment. In the Netherlands, the observed increase of accident rates in contractor firms in the chemical sector led to the introduction of the VCA (certificate for subcontractors) (European Agency, Marketing and Procurement, 2000).

Huuhtanen and Kandolin (1999) refer to a Scandinavian study from 1995–96 that has revealed a 10–15 % higher rate of accidents for temporary workers in industry than for workers in permanent jobs. No differences in accident rates could be found in service work between temporary and permanent jobs (Report of Federation of Accident Insurance Institutions, 1999, cited in Huuhtanen and Kandolin, 1999). Clifton (2000) states that new structures of enterprises can, in some respects, have a negative effect on health and safety at work because pressures are experienced by the informal management structures of very small firms. This is because they mainly rely on the support of external health and safety services for the development of their prevention and risk management policies and they lack in-house expertise that may cause a deficiency of risk awareness, which may lead to neglecting health and safety standards.

2.1 Part-time and Casual Employees

Part-time and casual employees are a significant, and growing, proportion of the Australian workforce (Burgess & Campbell, 1998). Quinlan and Mayhew suggest: the growth of precarious employment is liable to undermine theeffectiveness of existing regulatory apparatuses, make it more difficult tomanage OSH in their workplaces, and inhibit employee and unioninvolvement in OSH. This may erode the basis for developing moresystematic approaches to OSH management, including the most elaborateexpression of this in OHSMS (Quinlan & Mayhew, 2000). Overseas research has found 'The more casualised jobs are, the less of a prioritypprevention is' (Vogel, 1999:42). Non-permanent workers have less knowledge about safety issues, are more constrained from refusing work environment deficiencies, and find it more difficult to be heard in relation to poor work environment issues (Aronsson, 1999). Fixed-term and short-term employees have also been identified as having significantly higher levels of workplace injuries than permanent employees (Francois, 1995; and also Isaksson et al., 2000). Australian research on part-time and casual employees and OSH is more limited, with only one major study of young casual workers in the fast-food industry (Mayhew, 2000). These workers were found to have a relatively high knowledge of OSH, but the findings of this research have been viewed as peculiar to the firm and above average for the industry (Quinlan & Mayhew, 2000:194).

Furthermore, the ArcelorMittal Joint Global Health and Safety Committee (JGHSC) believe that contractor safety performance should be a high priority. Results on figure 2.1 below show that contractors do not perform to the same level as ArcelorMittal's own employees. The experience of the JGHSC site visits is that poor contractor performance undermines safety standards and greater attention needs to be given to the implementation of the existing corporate guidelines. The local JHSC can play a vital role in achieving compliance and higher standards by working together on this issue. Greater attention must be given to the enforcement of ArcelorMittal's internal standards and ensuring that all contractor companies comply with them.

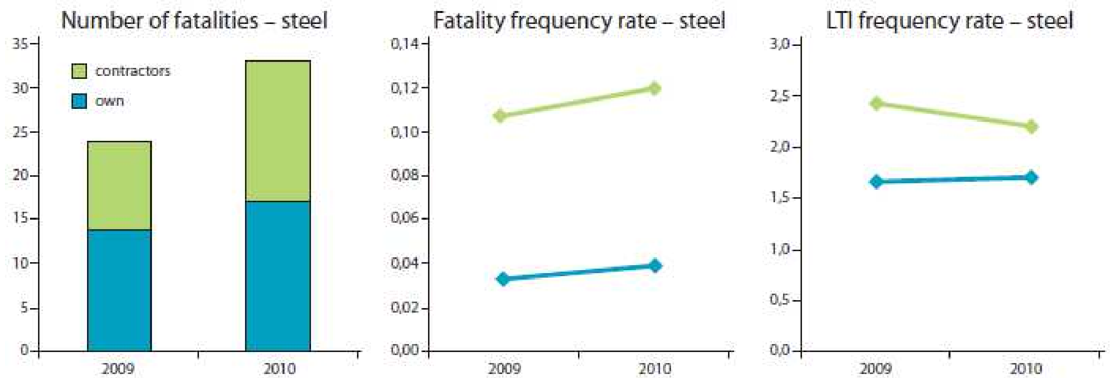


Figure 2.1 : Analysis of fatalities comparing the performance of the employees and contractors.

How do organisations reliant on part-time and casual employees adapt their OHSMS to accommodate these employees? Consultations suggested that on the whole, part-time and casual employees are excluded from the operation of OHSMS. Their weak involvement in OHSMS was paralleled to that on other employment issues. They have less involvement in consultative processes, an absence of on-going training, and less detailed knowledge and experience of the workplace (Dianna Alder, WorkCover SA; ACIRRT, 1999:141). In some areas of employment, there has been 'such an influx that they justmiss out on being part of the system'. Experts consulted agreed that companies generally did not take additional steps to incorporate casuals and part time employees into their OHSMS, and that these employees were informed about OHSMS issues only through compulsory induction training. A distinction was often drawn in consultations between part-time and casual employees, with casuals perceived as the most excluded group:

- Part-timers – they can become part of the workplace culture…casuals less so, they're the most disadvantaged.
- Casual's don't get the training…it's a fact of life.

The Australian Workplace Industrial Relations Survey of 1995 confirms these views.

Casual employees were less likely to receive job-related training than non-casuals, and only 24% of casual employees had received OHS training compared to 36% of non-casuals (ACIRRT, 1999:141). The exclusion of casuals is seen as inherent to current OHSMS tools - 'OHSMS assume a stable workforce' (Michael Quinlan, UNSW). That casual workers, as well as some part-time employees are excluded from OHSMS – from the process of identifying hazards and participating in OHS committees - was seen as an issue of real concern in consultations. 'They are alienated from that process…that's a real challenge.

2.2 Contractor management

Contractors appear to be contributing a larger proportion of incidents. Several operations identified contractor management as a safety challenge. At Bengalla, contractors are allocated to teams of employees. This scheme aims to combat the difference in safety awareness and practices between contractors and employees. This is also a way to make contractors feel "at home" instead of feeling they are outsiders and encourage behavioural changes in line with the Bengalla safety ethos.

At Kaltim Prima, a contractor is also assigned to be with an employee to help ensure the contractor gets by with the site safety requirements. The employee plays the role of a "custodian". At both Spring Creek and Cordera Rojo a similar scheme involves an employee who is tasked to review the work area of the contractor.

2.3 Safety culture

A good safety culture is a work environment where all members of the organisation share a high safety ethic. Either fatalism, or production-first thinking, provokes the negligence of hazards in a bad safety culture. Top management commitment is essential to promote a safety culture (Saari, 2001). Companies that embrace social values and act conscientiously according to their mission statement seem to generate a positive mentality and significant involvement on the part of their employees. A coherent policy, starting with a mission statement and realised through concrete initiatives, programmes and actions, within and outside the company, can mobilise employee commitment. This influences, in a positive way, the safety culture as a whole and even the individual risk behaviour of the employees.

Saari (2001), states that the zero accident vision is not directly a goal in the usual sense. Rather, it is a way of thinking that all accidents are preventable. It is too common for people to accept accidents, or a certain level of accidents, just because they think prevention is impossible in that situation. In this way, many hazards and injuries are tolerated without attention. The higher safety goals to which work organisations commit themselves are a step towards higher adoption of zero accident vision. Promoting this vision is an important weapon in the battle against fatality, which is still far too common.

2.3.1 Safety Culture and Safety Climate

Current interest in the topic of safety culture appears to have begun from the Chernobyl tragedy in 1986 (Mearns and Flin 1999). Bhopal is the site of probably the greatest industrial disaster in history. In the early hours of 3rd December 1984, a pesticide plant owned by Union Carbide, a US-based multinational company, released a cloud of deadly gas into the atmosphere (Srivastava, 1992). Within minutes, it had drifted over the sleeping town of Bhopal in India. Estimates of the number of deaths on that night vary widely. The Indian government's official estimate is that 1,700 people died within 48 hours. Unofficially, it is said that around 6,000 people perished in the days immediately following the gas leak. What is certain is that the victims of Bhopal suffered horribly, most of them drowning in their own bodily fluids as the gas attacked their lungs. To date, over 20,000 people have died as a result of the accident. An estimated 10-15 people suffer crippling, gas-related deaths each month. More than 50,000 are too sick to work, while around 5,000 families continue to drink poisoned water. As a result, the infant mortality rate is significantly higher in Bhopal than in the rest of the country. The Bhopal disaster was a result of a combination of legal, technological, organisational, and human errors (Rasmussen, 1997).

The identification of a "poor safety culture" as a factor contributing to the disaster led to many studies on safety culture in different high-hazard, high-risk industries. Using mainly employee surveys, many studies have sought to establish the significance of human factors in accidents and determine what factors distinguish workplaces with positive and negative safety records.

In broad terms, safety culture is understood as the embodiment of a set of principles which define how an organisation manages health and safety. It is also viewed as "all forms of learned behaviour which add up to a shared commitment to think safely, behave safely and to believe and trust in the safety measures put in place by the organisation" (Harvey, et al. 1999:10).

A term that is closely related to safety culture is "safety climate" which includes the "employees' perceptions, attitudes, and beliefs about risk and safety" (Mearns and Flin 1999:5). Although used synonymously and interchangeably to describe an organisation's state or condition of safety, the two concepts -- safety culture and safety climate -- are distinct. Safety culture is considered to be a more multifaceted and enduring set of characteristics reflecting basic values, norms, beliefs and expectations, which to some extent reside in the larger culture of the society. Safety climate is typically measured by questionnaire surveys and provides a "snapshot" of an organisation's current state of safety.

2.3.2 "Culture" as interpreted and understood in the present study

Culture as applied in this study adopts Tylor's encompassing classical definition: "*that complex whole which includes knowledge, belief, art, morals, law, custom and any other capabilities and habits acquired by man as a member of society*". Thus in characterising the cultural factors that impinge on safety at the workplace, macro-environmental forces such as political factors and economic or industrial imperatives have been included.

Safety culture refers to those organisational concepts that encompass an organisation's ideas and initiatives towards safety. A safety culture, the idea and initiative of which more often comes from management, may be (inadvertently) top-down driven. The definition of safety culture by Turner, et. al (1989) is also appropriate for this study: the set of beliefs, norms, attitudes, roles, and social and technical practices that are concerned with minimising the exposure of people to conditions considered dangerous or injurious.

Culture at the workplace will be simply referred to as workplace culture, a term that is broader than safety culture. The characterisation of the workplace includes looking at all the interacting elements, i.e., the organisational factors, job factors, and individual factors.

2.4 Accident Causation Theories

Why do accidents happen? This question has concerned safety and health decision makers for decades, because in order to prevent accidents we must know why they happen. Over the years, several theories of accident causation have evolved that attempt to explain why accidents occur. Models based on these theories are used to predict and prevent accidents.

Traditionally, accidents have been viewed as resulting from a chain of failure events, each related to its “causal” event or events. Almost all safety analysis and risk assessment techniques are based on this linear notion of causality, which have severe limitations in the modelling and analysis of modern complex systems. As opposed to conventional engineered systems, modern complex systems constitute different kinds of elements, intentional and non-intentional: social institutions, human agents and technical artefacts (Kroes et al., 2006).

One of the earliest accident causation models is the Domino theory proposed by Heinrich in the 1940s (Heinrich et al., 1980), which describes an accident as a chain of discrete events which occur in a particular temporal order. This theory belongs to the class of sequential accident models or event-based accident models, which underlie most accident models such as Failure Modes and Effects Analysis (FMEA), Fault Tree Analysis (FTA), Event Tree Analysis, and Cause-Consequence Analysis (Leveson, 1995). These models work well for losses caused by failures of physical components or human errors in relatively simple systems. Typically, in these models, causal factors in an accident which was not linked to technical component failures were classified as human error as a kind of catchall or "garbage can" (Hollnagel, 2001). These models are limited in their capability to explain accident causation in the more complex systems that were developed in the last half of the 20th century.

2.4.1 Domino Theory

According to Domino theory there are five factors in the accident sequence: 1) social environment (those conditions which make us take or accept risks); 2) fault of the person; 3) unsafe acts or conditions (poor planning, unsafe equipment, and hazardous environment); 4) accident; 5) injury. These five factors are arranged in a domino fashion such that the fall of the first domino results in the fall of the entire row (Figure 2.2) below. This illustrates that each factor leads to the next with the end result being the injury

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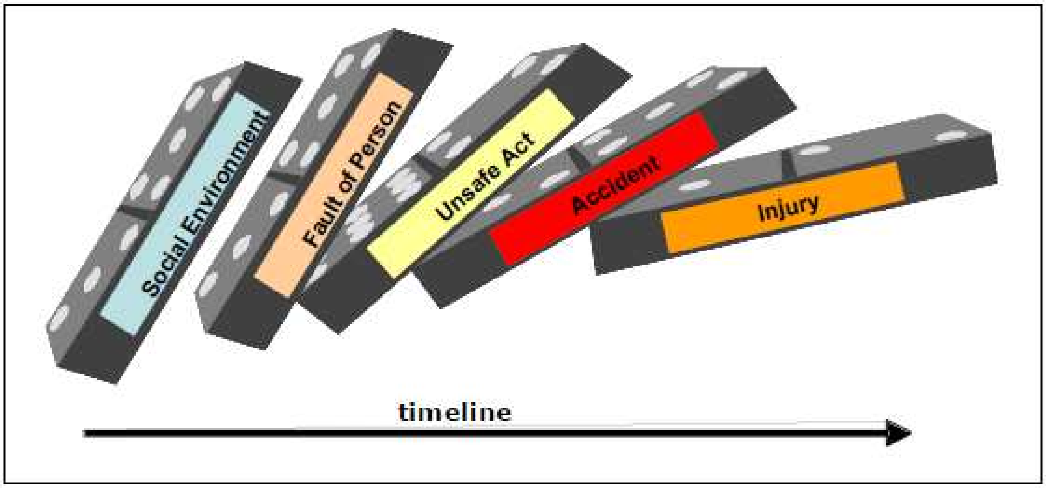


Figure 2.2 Heinrich's Domino Model of Accident Causation

An undesirable or expected event (the root cause) initiates a sequence of subsequent events leading to an accident. This implies that the accident is the result of a single cause, and if that single cause can be identified and removed the accident will not be repeated. The reality is that accidents always have more than one contributing factor.

In the 1980s, a new class of epidemiological accident models endeavoured to explain accident causation in complex systems. Epidemiological models regard events leading to accidents as analogous to the spreading of a disease, that is, as the outcome of a combination of factors, some manifest and some latent, that happen to exist together in space and time. Reason's (1990; 1997) Swiss cheese model of defences is a major contribution to this class of models, and has greatly influenced the understanding of accidents by highlighting the relationship between latent and immediate causes of accidents.

2.4.2 Swiss Cheese Model

Reason (1997) defines organisational accidents as situations in which latent conditions (arising from such aspects as management decision practices, or cultural influences) combine adversely with local triggering events (such as weather and location.) and with active failures (errors and/or procedural violation) committed by individuals or teams at the sharp end of an organization, to produce the accident.

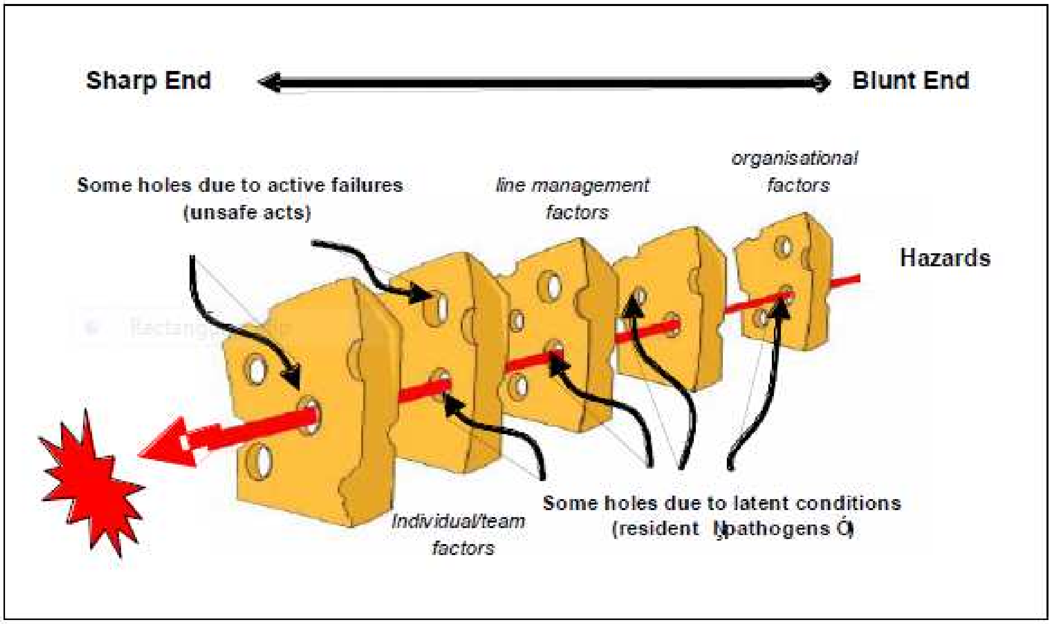


Figure 2.3 Swiss Cheese Model of Defences (Reason, 1997)

Reason's model is based on the defences in depth philosophy from military and nuclear power plant industry, that is a defensive system that involves many layers of barriers, each designed to support the other in order to reduce the likelihood of occurrence of an accident or disaster. The dynamics of accident causation are represented in the Swiss cheese model of defences (Figure 2.3) above, which shows an accident emerging due to holes in barriers and safeguards.

2.4.3 The Human factors theory

The human factors theoryof accident causation attributes accidents to a chain of events ultimately caused by human error. It consists of the following three broad factors that lead to human error: overload, inappropriate response, and inappropriate activities see Figure 2.4 below. These factors are explained in the following paragraphs.

2.4.3.1 Overload

Overload amounts to an imbalance between a person’s capacity at any given time and the load that person is carrying in a given state. A person’s capacity is the product of such factors as someone’s natural ability, training, and state of mind, fatigue, stress, and physical condition. The load that a person is carrying consists of tasks for which he or she is responsible and plus burdens resulting from environmental factors(noise, distractions, and so on), internal factors(personal problems, emotional stress, and worry), and situational factors(level of risk, unclear instructions, and so on). The state in which a person is acting is the product of his or her motivational and arousal levels.

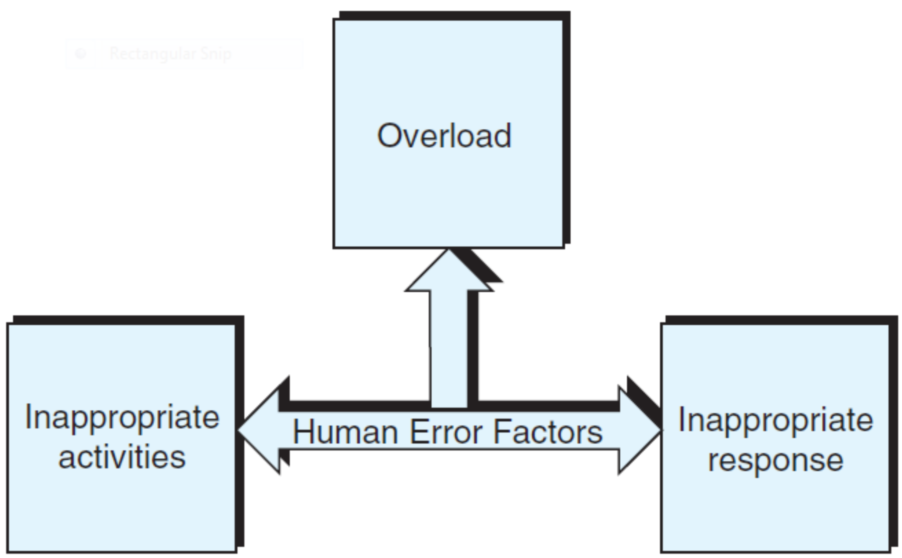


Figure 2.4 Factors that cause human errors.

2.4.3.2Inappropriate Response and Incompatibility

How a person responds in a given situation can cause or prevent an accident. If a person detects a dangerous condition but does nothing to correct it, he or she has responded inappropriately. If a person removes a safeguard from a machine in an effort to increase output, he or she has responded inappropriately. If a person ignores an established safety procedure, he or she has responded inappropriately. Such responses can lead to accidents. In addition to inappropriate responses, this component includes workstation incompatibility.
The incompatibility of a person's workstation in relation to size, force, reach, feel, and similar factors can lead to accidents and injuries.

2.4.3.3 Inappropriate Activities

Human error can be the result of inappropriate activities. An example of an inappropriate activity is a person who does a task that he or she doesn't know how to do. Another example is a person who misjudges the degree of risk involved in a task at hand given task and proceeds based on that misjudgement. Such inappropriate activities can lead to accidents and injuries. Figure 2.5 below summarizes the various components of the human factors theory.

2.4.3.4 Human Factors Theory in Practice

Kitchenware Manufacturing Incorporated (KMI) produces aluminium kitchenware for commercial settings. After 10 years of steady, respectable growth in the U.S. market, KMI suddenly saw its sales triple in less than six months. This rapid growth was the result of KMI's successful entry into European and Asian markets. The growth in sales, although welcomed by both management and employees, quickly overloaded and, before long, overwhelmed the company's production facility. KMI responded by adding a second shift of production personnel and approving unlimited overtime for highly skilled personnel. Shortly after the upturn in production, KMI began to experience a disturbing increase in accidents.

During his accident investigations, KMI's safety manager noticed that human error figured prominently in the accidents. He grouped all the human errors identified into three categories: (1) overload, (2) inappropriate response, and (3) inappropriate activities.

In the category of *overload*, he found that the rush to fill orders was pushing production personnel beyond their personal limits in some cases, and beyond capabilities in others. Stress, insufficient training of new employees, and fatigue all contributed to the overload. In the category of *inappropriate response*, the safety manager determined that many of KMI's production personnel had removed safeguards from their machines in an attempt to speed up production. All the machines involved in accidents had had safeguards removed.

In the category of *inappropriate activities*, the safety manager found that new employees were being assigned duties for which they weren't yet fully trained. As a result, they often misjudged the amount of risk associated with their tasks. With enough accident investigations completed to identify a pattern of human error, the safety manager recommended for corrective measures for KMI's executive management team. His recommendations were designed to prevent human-error-oriented accidents without slowing production.

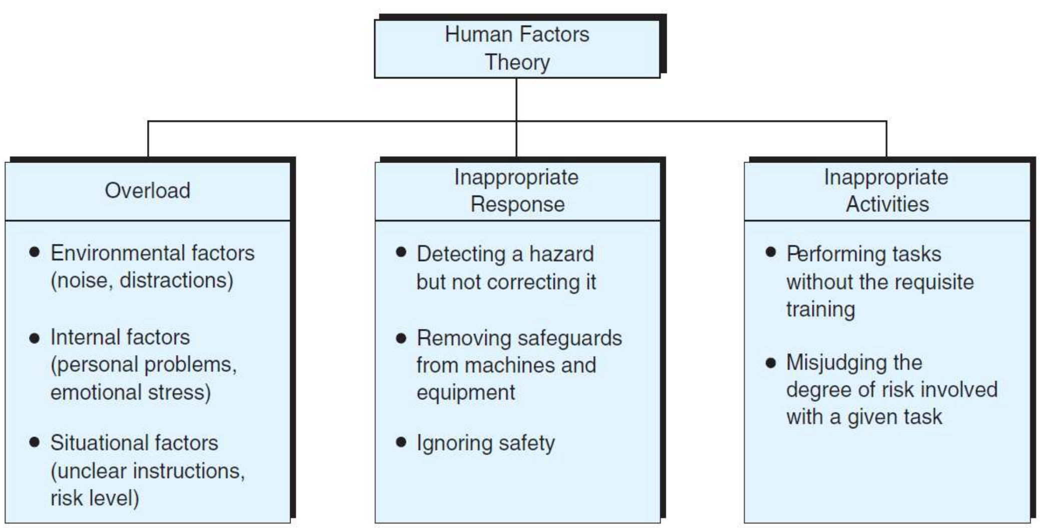


Figure 2.5 Human factors theory.

2.4.4 The behavioural theory

The behavioural theory of accident causation and prevention is often referred to as **behaviour-based safety (BBS)**. BBS has both proponents and critics. One of the most prominent proponents of BBS is E. Scott Geller (1998a), a senior partner of Safety Performance Solutions, Inc., and a professor of psychology. It is appropriate that Geller is a professional psychologist because BBS is the application of behavioural theories from the field of psychology to the field of occupational safety. According to Geller, there are seven basic principles of BBS:

(1) intervention that is focused on employee behaviour;

(2) identification of external factors that will help understand and improve employee behaviour (from the perspective of safety in the workplace);

(3) direct behaviour with activators or events antecedent to the desired behaviour, and motivation of the employee to behave as desired with incentives and rewards that will follow the desired behaviour;

(4) focus on the positive consequences that will result from the desired behaviour as a way to motivate employees;

(5) application of the scientific method to improve attempts at behavioural interventions;

(6) use of theory to integrate information rather than to limit possibilities; and

(7) planned interventions with the feelings and attitudes of the individual employee in mind.

BBS is an innovative and practical application of standard behavioural theory to the field of occupational safety. These theories are relevant in any situation in which certain types of human behaviours are desired while others are to be avoided. Positive reinforcement in the form of incentives and rewards is used to promote the desired (safe) behaviours and to discourage undesirable (unsafe) behaviours. Proponents of BBS use the “ABC” model to summarize the concept of understanding human behaviour and developing appropriate interventions when the behaviour is undesirable (unsafe). Geller explains the model as follows: Behaviour-based safety trainers and consultants teach the ABC model (or three-term contingency) as a framework to understand and analyse behaviour or to develop interventions for improving behaviour. As given in BBS principle 3 . . . the "A" stands for activators or antecedent events that precede behaviour ("B") and "C" refers to the consequences following behaviour or produced by it. Activators direct behaviour, whereas consequences motivate behaviour.Two other advocates of BBS, Bruce and Lori (1999), propose the expansion of the ABC model to ABCO. The "O" stands for outcomes. They explain the addition as follows: "*Outcome*" refers to the longer-term results of engaging in safe or unsafe behaviour. For example, an antecedent of a sign requiring employees to wear safety goggles could produce the behaviour of putting on the goggles, the consequence of avoiding an eye injury, and the outcome of being able to continue working and enjoying time with the family. On the other hand, the consequence of not wearing goggles could be an eye injury with a potential outcome of blindness, time off the job, and a reduced quality of life. Failure to address the issue of outcomes represents a lost opportunity to give employees a good reason for engaging in safe behaviours.

According to Factories and Works Act Chapter 14.08 (1996), the issue of human behaviour is of paramount importance with regards to preventing accidents at work place. The purpose of safety and health legislation is to regulate the conditions of work and to control behaviours in accident prevention. They also provide the minimum standard of decent safe work that should be collectively maintained by all employees.

2.4.4.1 Behavioural Theory in Action

Mark Potter is the safety manager for Excello Corporation. Several months ago, he became concerned because employees seemed to have developed a lax attitude toward wearing hard hats. What really troubled Potter was that there was more than the usual potential for head injuries because of the type of work done in Excello's plant, and he had personally witnessed two near misses in less than a week? An advocate of BBS, he decided to apply the ABC model in turning around this unsafe behaviour pattern. Firstly he removed all the old "Hard Hat Area" signs from the plant and replace them with newer, more noticeable signs. Then he scheduled a brief seminar on head injuries and cycled all employees through it over a two-week period. The seminar took an unusual approach. It told a story of two employees. One was in a hospital bed surrounded by family members he did not even recognize. The other was shown enjoying a family outing with happy family members. The clear message of the video was "the difference between these two employees is a hard hat." These two activities were the antecedents to the behaviour he hoped to produce (all employees wearing hard hats when in a hard hat area). The video contained a powerful message and it had the desired effect. Within days, employees were once again disciplining themselves to wear their hard hats (the desired behaviour). The consequence was that near misses stopped, and no head injuries have occurred at Excello in months. The outcome of this is that Excello's employees have been able to continue enjoying the fruits of their labour and the company of loved ones.

2.4.4.2 Bradley Curve

DuPont Solutions, (2013:1) goes on to highlight Bradley curve which shows the reaction anticipation span on behaviour. The curve emphasis the behaviours portrayed at interdependence which is the desired stage for achieving zero harm.

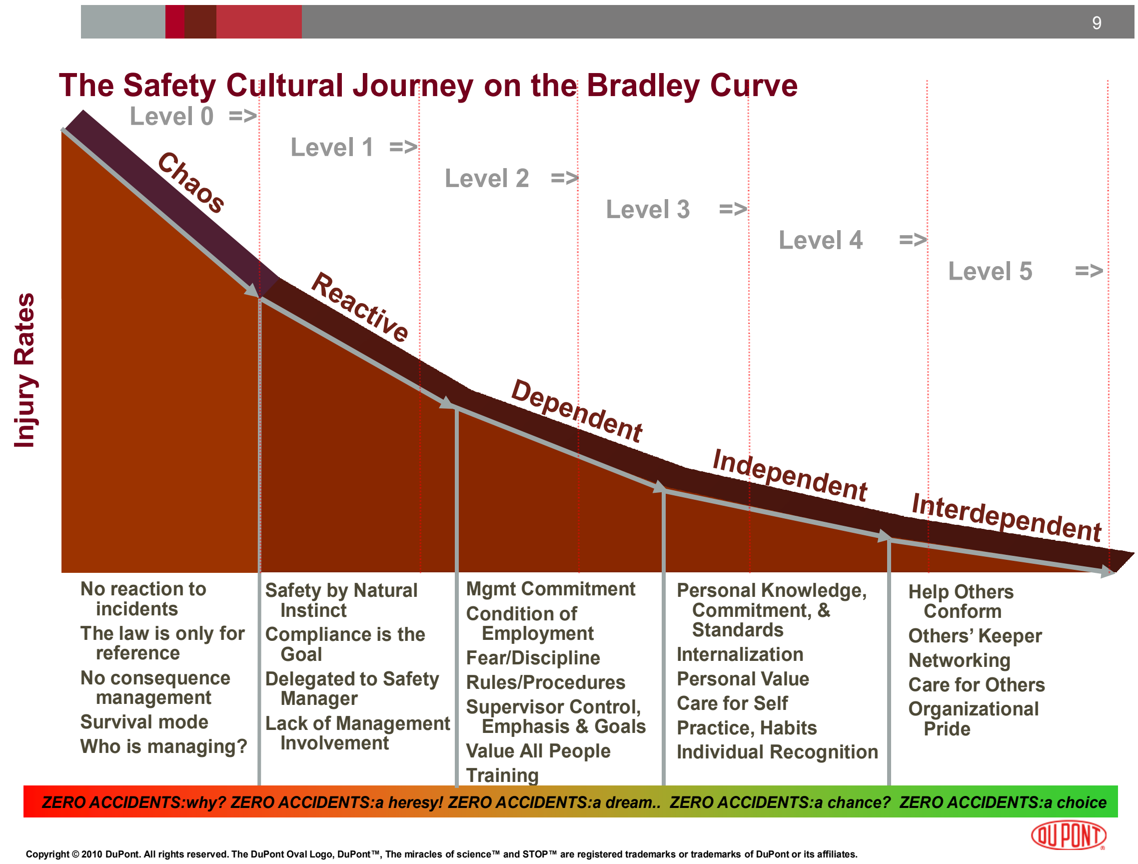


Figure 2.6 DuPont Bradley Curve. Source: www.safety.dupont.com

The Bradley curve indicate the journey to zero harm where no harm at interdependent is by choice not by chance. According to DuPont Solutions, (2013:3), the journey involves following the five steps:

Level 5: WORLD-CLASS - describes full openness and trust in the organisation with teams using each other strengths to achieve a clear end result. World-Class is a way of life.

Level 4: EXCELLENCE - describes ownership at team level for what the element is trying to achieve. Innovation is coming from the teams to improve thesystems. Refinement and advanced technology.

Level 3: SKILL - describes good understanding amongst most people about what should be achieved and the systems being used effectively. Basics in place with ownership.

Level 2: AWARENESS - describes good systems that trigger the right behaviours. The systems are mostly implemented. Stabilisation and awareness.

Level 1: INSTINCT - describes a situation where there is little evidence ofsystems and practices being implemented and no best practice.

Level 0: NOTHING – no visible signs of structures or a culture. No predictable reaction to an event or incident.

Improving an organization's safety culture takes time (DuPont solutions, 2013). An organisation may be able to reduce the number of injuries and incidents your work force experiences in a short period of time, but to truly shift culture and move through the above phases will not happen overnight. All should begin by evaluating where the organisation is then determine gaps and start taking initial steps. Furthermore, carry out observations and training and check to see whether you might be moving in the right direction.

2.5 OSH management system

2.5.1 An Outline of the OSH management systems

OSH management is that integral part of business management preoccupied with the control of conditions and factors that affect, or could affect, the safety and health of employees or other workers including temporary workers and contractor personnel, visitors or any other person in the workplace. An OSH systems approach is based on OHSAS 18001 and ISO 14001 (EMS). This system is applied basing on the Deming's cycle of continuous improvement as summarized by Figure 2.7 below. This is illustrated as a continuous cycle of planning, implementation, evaluation and continual improvement. According to Standard Association of Zimbabwe (2007), an OSH management system is a management tool used to develop and implement OHS policy and manage all risks associated with the operation.

2.5.2 Elements of OHS management system

2.5.2.1 Policy

This is a statement of intent which will give a framework on how an organisation will conduct the OSH management system and its key elements are:

- be integral to the manner in which the company's management intends to pursue OHS improvement and be suitable for the characteristics of the company, including a clear intention regarding health as well as safety;
- state the intention to meet fully the legal and other related requirements keep up to date any changes in legal issues affecting the organisation.
- state the intention to identify and to eliminate or to control effectively any risks to health or to safety and to pursue continuous improvement in this regard;
- include general aims and objectives that encompass the company's approach to ensuring OHS compliance and improvement, relevant to the environment in which it operates;
- include mention of the importance of employees through communication and consultation in the achievement of safe and healthy working for themselves and others.

2.5.2.2 Planning and implementation

This refers to all operations to ensure that the identification of OSH hazards in working practices and the working environment, the assessment of the risks they incur to any persons and the implementation of necessary control measures to eliminate or to render the risks as low as is reasonably practicable. As far as is reasonably practicable, the persons who are to carry out the work should be involved in carrying out the assessment, while management shall always ensure that appropriately qualified and experienced persons are involved. In all instances, all affected employees, contractors or other persons shall be made fully aware of the content and outcome of the assessment. Apart from that, on legal and other requirements, the company shall define responsibilities (e.g. within job descriptions) for ensuring that it keeps abreast of legal OSH requirements that are applicable to it and that everyone is fully informed of any aspects of which they may need to be aware.

Planning and implementation requires resources which include human resources with specialised skills or develop employees to achieve competence in tasks they perform through training needs identification. The other resource that is required is financial resource to sustain the OSH management system in infrastructure and technological development to meet set objectives so that it is well implemented, developed and maintained.

2.5.2.3 Checking and corrective action

The measurement and monitoring of appropriate characteristics of OSH performance (including legally specified requirements such as health hazard exposure limits) it’s very critical in ascertaining continual improvement. Characteristics to be measured are likely to include:

- progress towards achievement of OH&S objectives at all levels;
- quantitative trailing indicators of performance such as the numbers, severity and patterns of injuries and incidents, lost time and reportable injuries and incidents, trends in the lost time injury frequency rate, ill health, absences, related financial costs;
- leading indicators of performance such as:
    - ✓ Appearances by senior managers supporting OHS activities
    - ✓ High-level OH&S objectives in board-level objectives
    - ✓ All management team meeting agendas include OH&S
- Continuous improvement processes
    - ✓ Integration of OH&S improvement objectives into objective setting/review for managers.
    - ✓ Comprehensive nature of the audit programme
    - ✓ Number of non-conformity (N/C) counts at audit
    - ✓ Handling time for N/Cs and observations (corrective action)
    - ✓ Investigation of significant incident root causes and preventive action
    - ✓ Frequency of review of risk assessments / systems of work
    - ✓ Site inspections and assessments (health as well as safety)

2.5.2.4 Review and improvement

In addition to the ongoing monitoring of OSH performance, at least annually a comprehensive review of the suitability, adequacy and effectiveness of the OHS management system itself should be carried out and a record kept. Any agreed improvements shall be undertaken, typically managed by objectives with timescales.

2.5.2.5 Continual improvement

According to SAZ (1996) continual improvement is based on the continuous evaluation of OHS performance for identifying opportunities for improvement. This entails that through management review meetings and system audits deficiencies within the system is identified and they are corrected through programs or setting objectives to achieve excellence.

SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT (PDCA) MODEL

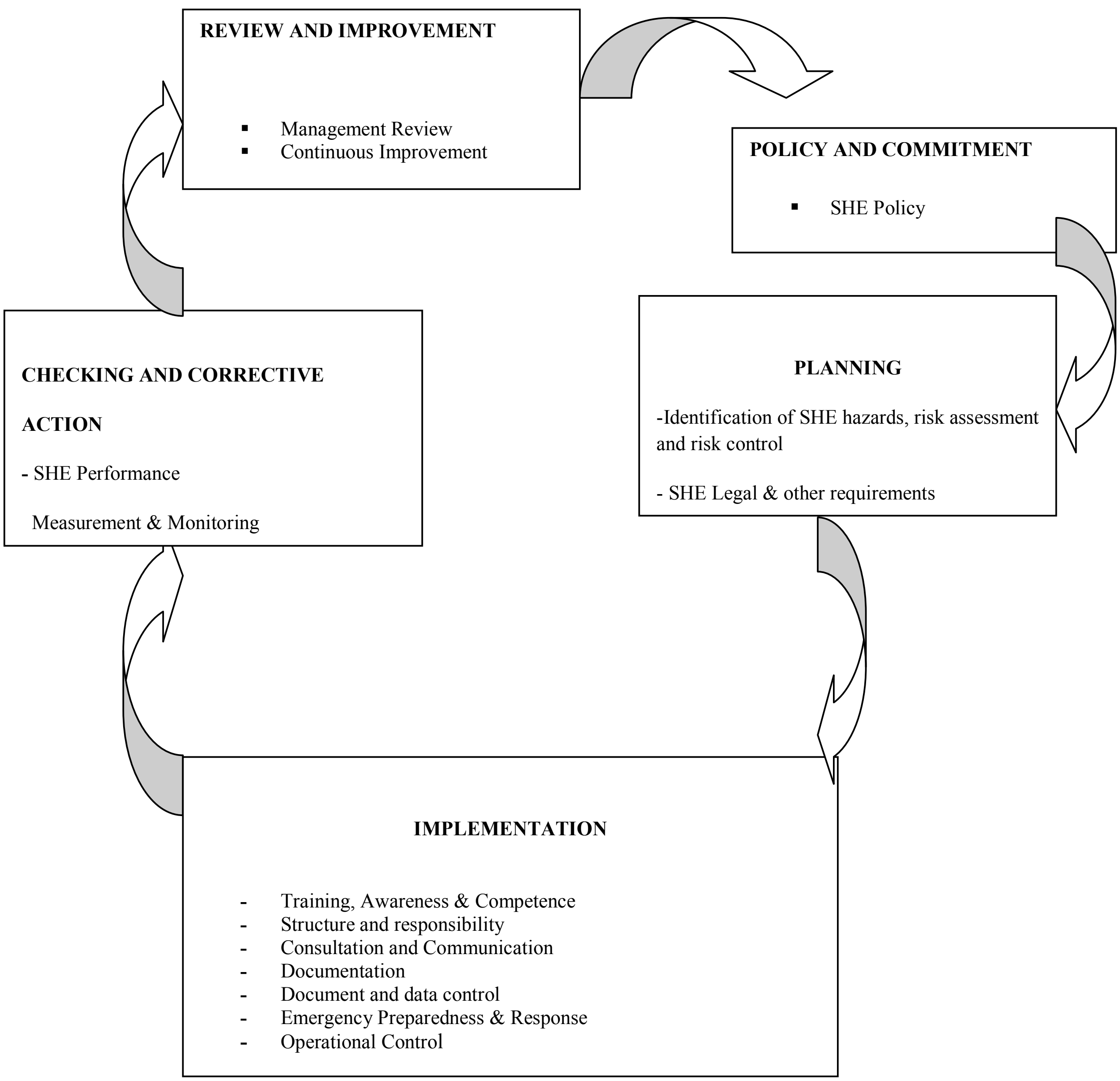


Figure 2.7 PDCA cycle model. Source: ISO 14000 & OHSAS 18001 Management Systems

In addition to OSH management system it is strengthened or supported through risk management system. According to Modaress (1999), risk assessment is defined as the identification, evaluation, estimation of the levels of risks involved in a situation, their comparison against benchmarks or standards and determination of an acceptable level of risk. This definition is also supported by Dr Moyo (2002), who defined risk management as a multitentacled and holistic approach in hazard identification, risk assessment and control and monitoring of hazards. Furthermore, Brady (2005) stressed the importance of coming up with controls or mitigation measures as an important stage which completes the risk assessment process.

Incoming up with the risk assessment ,the following key stages are followed sequentially starting with the scope or context through to the identification of hazards assessment of risks up to the monitoring and review as shown by Figure 2.8 below

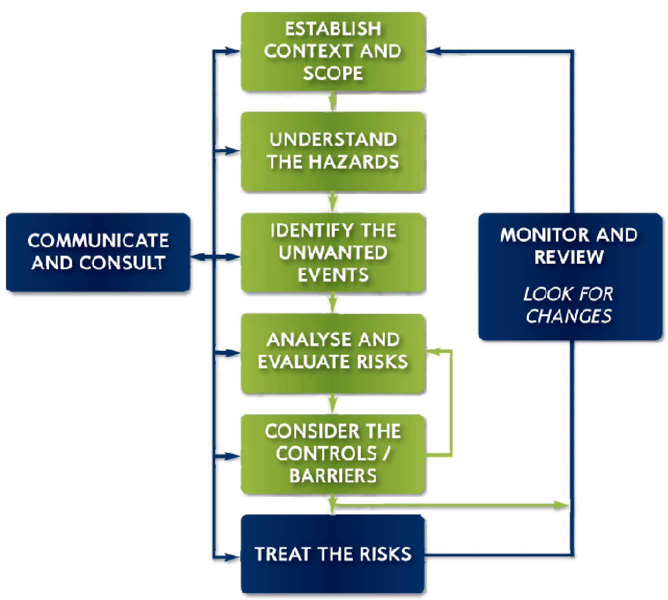


Figure 2.8 : Risk Assessment Framework

Source: Anglo American Group, SHE Risk Assessment Standard AAG-MIN-PLT-STD-079 of 2003

According to Neram (2001), the risk assessment framework is a tool that is used to look at the various components within an organization with a view to identify or predict potential hazards and asses the risks in order to prioritise their response management or control measure. The first stage according to the risk assessment framework will be to establish the scope or context of the risk assessment .In this regard, the scope of this risk assessment refers to operations of an organisation. According to OHSAS 18001 standard the scope or context of the risk assessment helps to identify the nature ,boundaries ,types ,characteristics and complexities of anticipated hazards and risks.

The next important stage in risk assessment will involve the identification of hazards, associated with the operations. According to NSSA presentation, 2012 it is important to categorise or classify hazards. The hazards classes are as follows: Biological, Chemical, Physiological (Ergonomics) and Physical. A hazard according to OHSAS 18001 is any situation, substance, activity, event or environment that could potentially cause injury or ill health.

Various sources will be relied in order to identify hazards. According to Anglo American plc group SHE Risk management Standard, AAG-MIN-PLT-STD-079 of 2003 it is important to rely on legal requirements, policies, standards and directives when conducting a risk assessment. Material Safety Data Sheet (MSDS) and Original Equipment Manufacturing (OEM) s is referred to as sources of information for the risk assessment.

After the identification of all potential hazards associated with the activities, products and or services of an operation, an assessment of the identified risk will be conducted. Jones (1999), defined an assessment of risk as determination of the risk level associated with unwanted events by means of likelihood of occurrence and consequences normally used to prioritize risk management efforts.

An idealistic matrix which looks at the probability of the risk occurring based on the frequency and exposure to the hazards against the consequence of the risk can be used.

Yakov (2009), pointed that the main objective of assessing identified risks is to be able to priorities risk according to their significant impact so as to direct control measures or management of risks. The following risk rates are distinct from the low to high risk as follows: Insignificant, minor, moderate, major and catastrophic.

In line with current practices in risk management, a variety of risk control measures will be adopted to manage all significant or prioritized risk. The Hierarchy of controls in selecting the appropriate and most effective control measure will be used. According to the hierarchy of controls principles, the ideal, most preferred and effective risk control in order of importance as follows: Elimination, Substitution, Engineering, Administrative and least being use of Personal protective equipment (PPE)

When the risk assessment has been completed, the team will continue to monitor and review all the steps of the assessments to check on adequacy, effectiveness and any areas that require continual improvements.

2.6 Safety performance measurement

According to Jorne et al (1997), reliable tools for measuring OHS performance are the leading indicators, lagging indicators and positive performance indicators.

2.6.1 Lagging indicators

Historically, the most commonly used indicators are those that measure "after the fact" information. Following an incident, injury statistics are recorded to identify the level of harm or potential for harm (including fatalities), and the immediate cause of the incident and the injury. These indicators are referred to as lagging (or outcomes) indicators. Lagging indicators measure final outcomes – they are tools that identify the hazard once it has manifest (Janicak 2003). Thus, the cause of the incident and its effects can be identified, but only after the incident and (potential) injury has occurred. Lagging indicators have been the focus of attention not least due to the ease of data collection and measurement, as well as having been driven by regulatory reporting requirements. They are essentially backward looking.

2.6.2 Positive performance indicators

Positive performance indicators refer to overall goals and objectives of OHS will also be used to measure performance. These include certification to ISO and OSHs standards as well as NOSA attainment standards, achievements of Chamber of Mines Audit trophy, NSSA safety awards and national first aid Chamber of Mines award.

2.6.3 Leading indicators

Leading Key Performance Indicators (KPIs) are those that will encourage the improvement of the Safety Management System (SMS) or its effectiveness over time by setting realistic and attainable objectives. They are essentially forward looking. This means identifying those aspects of the organization that pose the highest risk to desired OHS outcomes (OECD 2008). Depending where along the causal pathway the leading indicators are chosen, they can identify the initiating event(s) (root causes) and/or the contributory task, process, person, site or organizational elements or factors. In so doing, they can inform and direct appropriate preventative actions. Leading indicators allow organizations to measure the relative importance (weighting), effectiveness, applicability and relevance of policies, procedures, practices and activities in achieving desired OHS outcomes (OECD 2008). Examples of leading indicators are inspections, planned job observations, visible felt leadership, stop notes, peer to peer observations, and road behaviour checks, number of safety meetings, reporting near miss and hygiene surveys. The reporting of near miss incidents and peer to peer observations are indicators of OHS performance. These give the organisation the opportunity to improve because many activities happen at the sharp end as illustrated by figure 2.9 below. Under the workplace its activity and these activities spell out at risk behaviours and near misses.

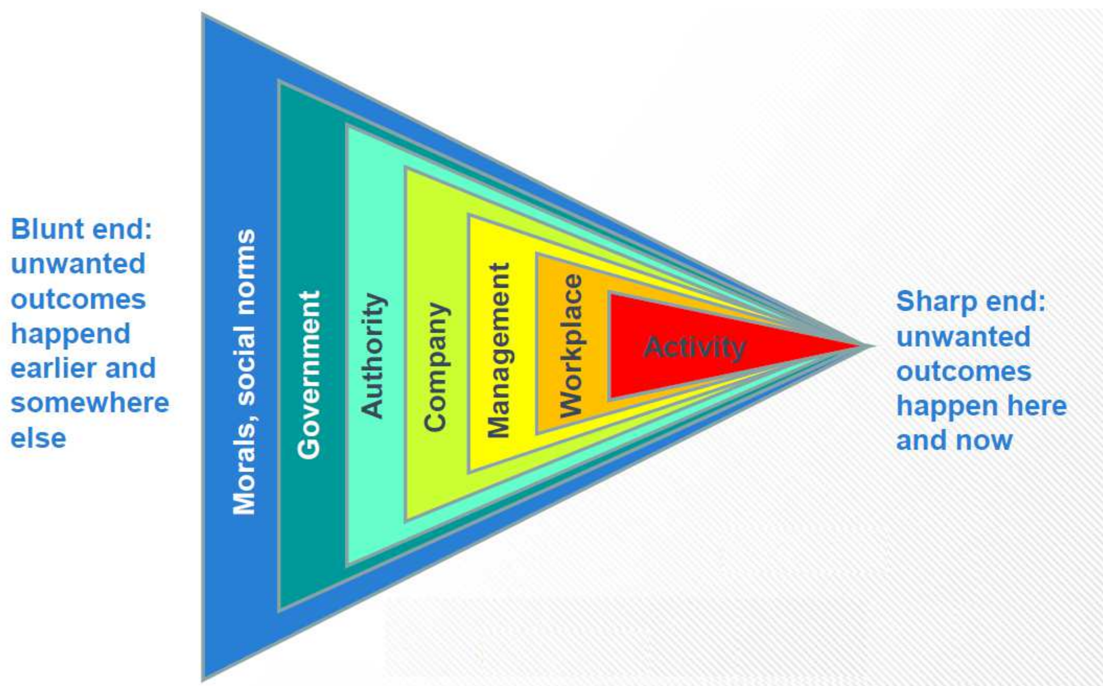


Figure 2.9 Sharp end versus blunt end adopted from Hollnagel 2004.

The other point to note is that further away we go from the sharp end, the more difficult it gets to take corrective actions in other words there is no direct control. A point to note also is that blunt end indicators can contribute to sharp end failures. A good example its safety culture, culture disseminate from the top. If there is no safety culture it will be shown by at risk behaviours, near misses and eventually accidents at the sharp end.

2.7 Safety performance in Zimbabwe.

According to Gonese et al (2001), occupational injuries are among the top ten health priorities. For the period of 2004 to 2009 the average for this 6 year period is Mining and Quarrying on top with 648 as shown by appendix 1 below followed by Basic metal Production which had an average of 633.

According to NSSA (2008), the injury rate among mining workers in Zimbabwe was 131 per 1000 exposed workers per year. The rates do not show the actual number which is contributed by contractors so that if there contribution is known is will be easier to address their issues. So, this warrant a research to clearly spell out if contractors are contributing significantly to high rate of occupational injuries in mining industry.

Chapter 3

RESEARCH METHODOLOGY

3.0 INTRODUCTION

This chapter outlined the ways and techniques that were employed by the researcher to gather and collect data for the research. Greenwood and Mayor (1990) described research as an investigation or enquiry undertaken with aid of a standardized procedure in order to obtain information. The procedure involved in data collection must be orderly, systematic and reputable to verify the information. Through the use of primary and secondary sources of data the researcher was able to solicit a large volume of information pertaining to the subject under study.

3.1 Research Design

The triangulation of qualitative and quantitative approaches in this was considered so as to ensure that the limitations of one approach will be covered by the strength of another. This approach used questionnaires, interviews, and secondary data analysis and field observations. This study design is basically a cross sectional study. A cross sectional study is a descriptive study in which a population or a subset is selected and from these individuals, data are collected to help answer research questions of interest (James, 1994). This research is called cross sectional because the information about evaluation of contractors' OSH management system was gathered represented what was going on at a particular point on time. The advantage of this design is that it does require follow-up and is therefore less costly and quicker than other designs. Another important point to note is that the data obtained often representative of a population rather than a smaller sub-population. A retrospective record of past events was reviewed which showed leading, lagging and performance indicators.

Research does not have a beginning or an end; researchers build on work that has already been done in order to add to it, thus providing more resources for other researchers to build on (Wesleyan University Library, 2008). This helped the researcher to review to what extent to which the contractor OHS management system has achieved in accident reduction and at risk behaviour. The study design assisted in coming up with the contractors' safety culture, effectiveness, and safety violations and compliance levels to OHS management system

3.3 Target population

According to Drunker (2000), population is defined as the collection of elements or subjects that possess the information sought by researcher and about which inference are to be made in this case, the researcher was concerned with evaluation of OSH management system of contractors in reduction of accidents.The key respondents in the study were the Contractor Management, Zimplats Operations Engineer, Zimplats Section Engineer, Contractor Site Foremen, Zimplats SHEQ Officer and Contractor SHEQ Officer/Representative. The study population is 688 contractors at Zimplats processing division. This was the population from which the sample was drawn. The sample size will be 172 which are 25% of the total population of contractors. See table 3.1 below.

Table 3.1: Sampling size. 1

Organisation	**Employees**	**Sample size (25%) of contractor employees.**
Contractors	688	172
Total	**688**	**172**

3.4 Sample size determination and selection

A sample is a subunit of a target population. Sample originates from the word 'example' (Wong, 1999: 36). Ideally the sample should be a good example or a true representation of the target population so that the values of the population may be estimated from the corresponding sample data. Furthermore, according to Youndi (2006), sampling is the process of selecting a group of subjects for a study in such a way that the selected individuals represent the larger group from which they were selected. Samples should provide a representative cross-section of the population they supposedly represent. Participants were randomly selected from departments and there were all easily accessible as they are at same location. Sample size rule of thumb was used; Gay (2006) to determine the total number of all employees and 25% of a 688 employees was used. There are four major types of sampling, random, systematic, and stratified and cluster sampling. Simple random selection was used where participants were drawn from different departments.

3.5 Research Instruments

3.5.1 Questionnaires

Farrant (1980) defined a questionnaire as an instrument that serves to measure specific aspects of researcher's objectives. This is supported by Gwimbi and Dirwai (2003:69) that the purpose of a questionnaire is to collect accurate and appropriate information from respondents. The questionnaire is designed to include both quantitative and qualitative data because of the nature of the project.The questionnaire included both open-ended and closed ended question so as to get further details of and greater depth, which goes beyond just description from closed ended questions. The questionnaire was designed in such a way that the questions were clear and unambiguous, short, avoided unnecessary jargon and specialist language. The questionnaire was structured insuch a way that it was easy and quick to answer. Most of the questions only required a tick in the appropriate box. The questionnaires targeted the bigger sized sample of contractors.A total of 172 questionnaires were distributed. The researcher chose to administer the questionnaires to a sample of 25% of the contractors as shown by the table3.1 above. Stratified sampling will be used in contractors which have more than 10 workers.

The researcher used purposive sampling whereby he gave questionnaires to respondents whom he found at the premises each time he visited their work stations. The researcher requested for all the number of workers from each contractor and used purposive sampling to administer the questionnaire to workers whom the researcher found at the site. Workers were stratified according to operating sub-sections in the contracting companies e.g. Boilermakers, Fitters, Electricians, Artisan Assistants, Civil Technicians, Riggers and Artisan Assistants. This ensured representation of all contracting workers within Zimplats. Since all the respondents were within Zimplats the researcher collected all responds to the questionnaires within a week. . The questionnaire had sub headings which corresponded with the objectives of the study. Some of the issues covered in the questionnaire were causes of accidents, establishment OSH management system, and efficacy of the OHS in accidents reduction and analysis of safety culture of contractors. See questionnaire in appendix 2 below.

Advantage of Questionnaire

A questionnaire is easy to administer (can be mailed or hand-delivered) and it can be administered in a relaxed atmosphere. Respondents were given ample time to respond to questions at their convenience and in this way meaningful and well thought information was solicited. Ensuring the validity of the data gathered.

Disadvantages of Questionnaire

The questionnaire does not have direct control over the respondents and some subjects may fail to complete thus leading to a low response rate. Furthermore, the researcher will not be available to answer to queries and this may lead to poor quality responses, thus reducing sample size and introducing bias

3.5.2 Semi Structured Interviews

Structured interactive interviews were used as a way collecting data. Harper, (1991), defined interviews as a method of collecting data asking personally for the required information. Data collecting techniques of interviewing involved oral questioning of respondents. See table 3.2 below. Interviews were undertaken with all the key informants within Zimplats operations. The researcher made appointments over the phone with all the key informants in table 3.2 below no when the researcher could come and interview them.

To reduce bias and give room to the interviewee to do much of the majority of the talking, the researcher used open ended questions. This enabled respondents to freely talk what is in their minds concerning establishment of contractors' to OSH management system. Interviews helped the researcher to get reliable and accurate information on the system requirements and gaps that exist. The interviewer probed on answers which were not clear. It allowed the interviewer to observe as well as listen and permits more complex questions to be asked than in other types of data collection. This was guided by interview guide appendix 3, 4 and 5.

Table 3.2: Personnel selected and reason

Personnel to be interviewed	**Reasons for interview**
Contractor Management	To evaluate OSH management system To assess safety culture.
Operations Engineer	To evaluate the contractor selection, implementation of contractor management procedure and safety management.
Section Engineer	To evaluate methods in place to manage contractors.
Contractor Site Foremen	To check adherence to contractor requirements according to safety management.
SHEQ Officer/SSD Manager	The OSH impacts of contractors and measures put in place to mitigate the impacts
Contractor SHEQ Officer/Representative	To assess compliance and sustainability of OSH system.

3.5.3. Observations

The researcher also used direct observations by going into the plant, noting down some observations without talking to anyone and also taking photographs. This included carrying out compliance inspections whilst the contractors are carry out their respective duties. This will give the researcher opportunity to have direct contact with what is happening on the ground and this is first-hand information. This will be guided by observation guide appendix 7.

3.5.4 Secondary data

Data was acquired through secondary sources that include company records, safety statistics, alcohol tests, road behaviour checks, peer to peer observations, planned job observations and visible felt leadership observations. These documents enabled the researcher to identify the company's lagging and leading indicators. Furthermore, secondary data provides a good background, as it is existing literature around the topic. This is supported by Hakim (1982) who argued that in answering research questions or meeting their objectives few researchers considered the possibility of re-analysing data that have already been collected for other purpose.Secondary data also facilitated appropriate scoping of the later stages of the site investigation. It also reduced wastage on inappropriate intrusive ground investigations.

3.6 Data collection

To collect the data, the researchers got permission from the management of Zimplats and appointments were made with them as regards to when the questionnaires were to be brought to them and collected for analysis. Appointments were again made with regards to the key formants as to when they were ready for the interviews to be undertaken. The questionnaires contained introductory statements so as to make the respondents aware of the objectives of the study. The introductory statement to respondents disclosed the aim of the research and conveyed its importance; assured confidentiality and encouraged reply. The researcher distributed and collected the questionnaires.

3.6.1 Pre- Testing of questionnaire

In a way to produce an effective questionnaire, the researcher pre-tested the questionnaire whereby ten respondents were being interviewed as a pilot survey. Bell (1993) advised that to do the best and give the questionnaires trial run, as without, won't know the impact of the questionnaire. This also was supported by Churchill and Lacobucci (2002:353) that the pre-test was the most inexpensive insurance the researcher could buy to assure the success of the questionnaire and the research project. The research questions were further scrutinised by experts in the field of research so that it will meet the intent. Basing on the comments by the interviewees and experts the researcher effected some adjustments such as re-arrangement of questions, avoidance of vagueness, ambiguity, bias, illogical sequence and deleting some questions which respondents felt they were a repetition. Pilot study also helped to reduce bias.

3.6.2 Control for bias

Bias is defined as any tendency which prevents unprejudiced consideration of a question. In research, bias occurs when systematic error is introduced into sampling or testing by selecting or encouraging one outcome or answer over others. Bias can occur at any phase of research, including study design or data collection, as well as in the process of data analysis and publication. Another school of thought argued that bias occurs when subjects, researchers or methodologies are influenced by external factors that alter the results of the study. Controlling these sources of bias is paramount to producing useful and authoritative results for a research. In order to control bias the researcher remained neutral and had no motivation for achieving one result over another so that the outcome would be real and unbiased.

Apart from that samples were selected randomly. Randomizing the sample prevented unfairly selecting one particular demographic, which may have different qualities or opinions than the general population. When looking at a particular population, randomly choose samples within that population to avoid biased selection of a subset of the population.

During interviews the researcher kept a neutral research environment. This neutrality was extending to the researcher, subject emotional state and the questioning area. The subject felt free to offer his true opinions. The interviewer held no significance to the subject's employment or personal life, as this could have altered his responses. If a subject was just fired or denied a promotion, this negative emotional state will influence his answers, so wait some time before interviewing him. The interviews conducted in private to avoid influences from having an audience.

The researcher kept interview questions neutral without leading the subject. Asking a subject, what do you think about OSH performance, pushed the subject toward a favourable response? Asking the person, "what is your opinion of risk assessment as a proactive tool to accidents reduction, keeps the question neutral. During a series of questions, the researcher would ask general questions before specific questions, so that the researcher would not offer too much information early in the interview. The questions were kept simple and easy to understand to avoid misinterpretation.

3.7 Data Analysis

Once data was collected, the researcher used codes in the analysis of data. Codes as defined by Seltiz (1976) are symbols, usually numbers that are used to identify particular responses or types of responses. The codes were used in the organization, quantification and analysis of data. The data was then put into frequency tables which were applied to critically evaluate contractors' OSH safety management system. This involved organising, ordering, describing and analysing the data. The researcher created coding categories that were in line with the research objectives and the information to be collected is then used to construct graphs, tables and pie charts. The data which was collected using the questionnaires was analysed and interpreted using a statistical package for social science (SPSS). This has an advantage of able to handle large volume of data as compared to other packages.

3.8 Ethical Consideration

Permission to conduct this study in the selected area was granted by Midlands State University and Senior Mine Management. The contractors' who were interviewed were given an explanation of what the research is about and what role they were playing in the research if they agreed to participate. The fact that the researcher administered the questionnaire face to face with the respondent made it easier for the contractors' to trust the intentions of the research. Therefore verbal informed consent was obtained from the respondents before administering of a questionnaire. Respondents were also informed that their participation in the research is entirely voluntary and their responses are purely for academic purposes. No names of contractor companies and names of interviewees would be published to allow free flow of information and also confidentiality. Codes numbers will be used instead of names to protect participant's rights to confidentiality.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

The chapter contains the results and discussion made from the data which was collected to answer the research questions and meet the specific objectives of the dissertation. The descriptive and inferential statistics were used in data analysis. The collected questionnaire data was analysed using a program known as Statistical Package for Social Sciences (SPSS).

4.1 Results

4.1.1 Response rate

The table 4.1 below shows a breakdown of the questionnaire responses. One hundred and seventy two questionnaires were distributed and one hundred and sixty**(n=160)** were returned. Twelve were unable to respond resulting in a **93%** response rate.

Table 4.1: Questionnaire Response Rate

DEPARTMENT	QUESTIONNAIRES DISTRIBUTED	QUESTIONNAIRES RETURNED	RESPONSE RATE %
Contractor	172	160	93%

Source: Primary data.

The Table 4.2 below shows a breakdown of the interview response. Twenty**(n=20)** interviews were conducted as targeted with a **100%** response rate. This was mainly for management staff for both contractors and Zimplats management in charge of projects/contractors

Table 4.2: Interview Response Rate

INTERVIEWS	TARGET	CONDUCTED	RESPONSE RATE
Contractor Management	5	5	100%
Operations Engineer	2	2	100%
Section Engineer	2	2	100%
Contractor Site Foreman	5	5	100%
SHEQ Officer	1	1	100%
Contractor SHEQ Officer/Representative	5	5	100%
TOTAL	**20**	**20**	**100%**

Source: Primary data.

The qualitative data were based on meanings expressed through words and resulted in the gathering of non-standard data which required classification and were analysed through the use of conceptualization and predicted theoretical explanations, standards and universally acceptable best practices.

The contractors were observed for conformity with safety and health standards. The observation and photographs were useful in validating and complementing the responses on questionnaires, interviews and records which were reviewed. The documents and records which were reviewed included accident statistics, road behaviour observations, pre-task risk assessment and peer to peer observation.

4.1.2 Results and Discussion

The aim of the study was to address specific objectives listed below:

- To establish causes of accidents in contractors.
- To evaluate establishment of contractor OSH management system.
- To determine efficacy of the OSH management system in accidents reduction.
- To analyse the safety culture of contractors.

4.1.3 Demographic data analysis.

Figure 4.1 below shows the demographic of respondents (n=160) against the age group. The data shows that most of the workforce is young that is 56% of the population are below 30

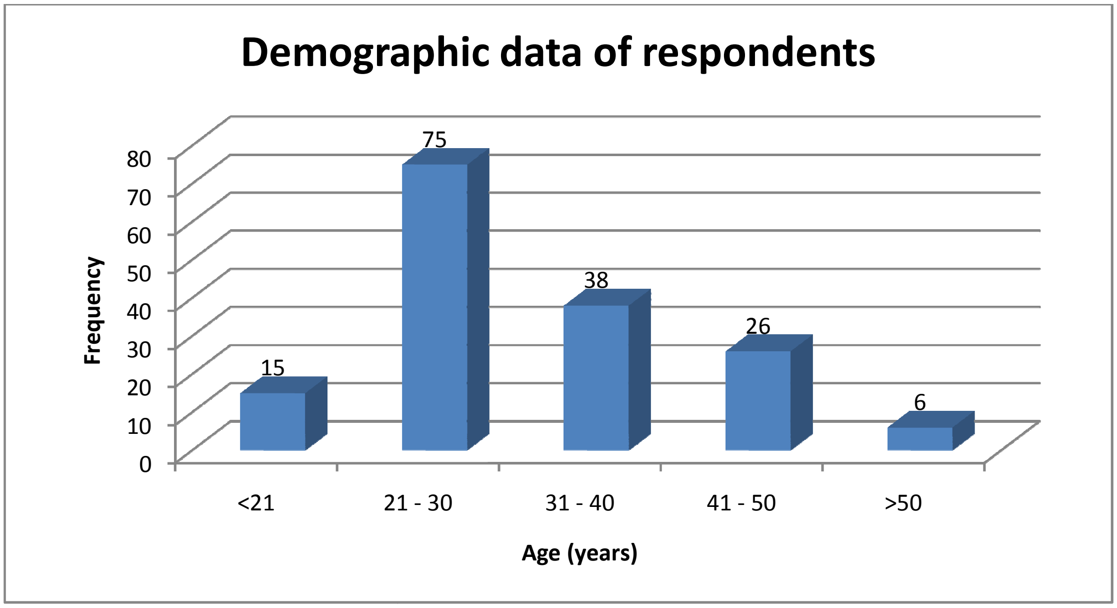


Figure 4.1 Demographic data of respondents

Apart from that, the majority of the contractors have a secondary education (76% of the population), 8% primary education, 13% have tertiary education and 3% have post graduate qualification as illustrated by figure 4.2 below. This data shows the preponderance is mainly unskilled labour comprising 84% and the minority is skilled labour which comprises 16%.

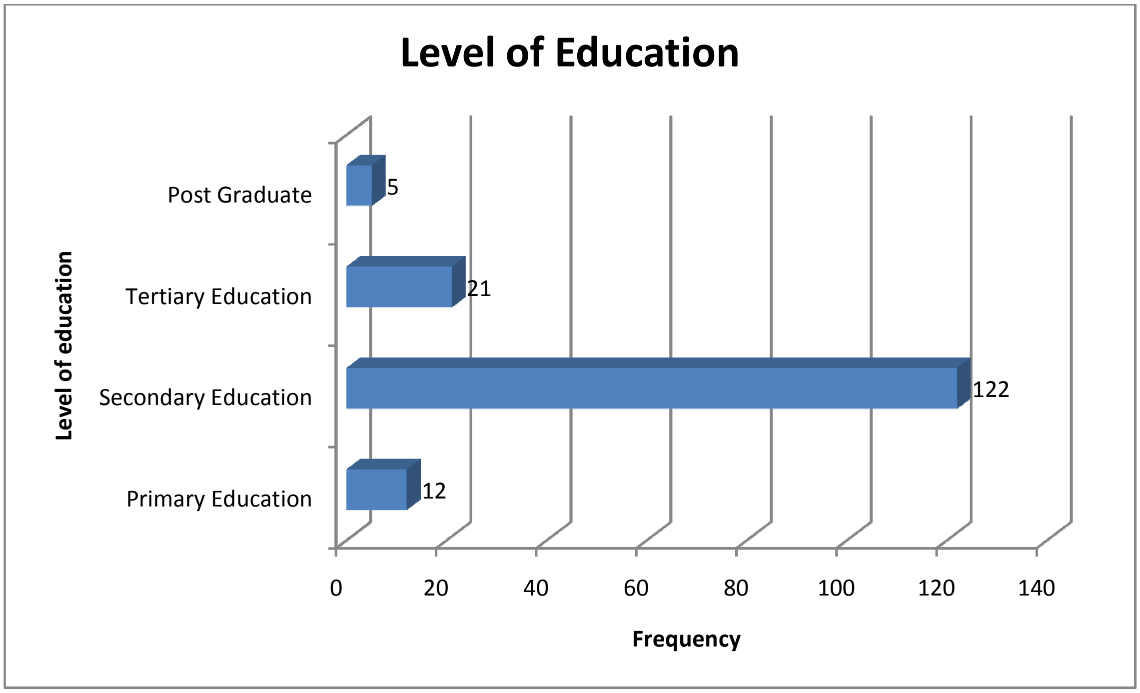


Figure 4.2: Level of Education. Source: Primary data.

Besides that, Figure 4.3below provide a blend of respondents (n=160) with differing years of service. The majority (46%) are between 0 – 5 years of service, while a less percentage (8%) is above 15 years. The remaining is 46% which is between 6 – 15 years of service. This data indicate that most of the employees or contractors are less experienced on the jobs which pose a challenge in managing risks at the workplace. They are fairly fresh from school or college and still want to experiment and learn how to articulate work challenges.

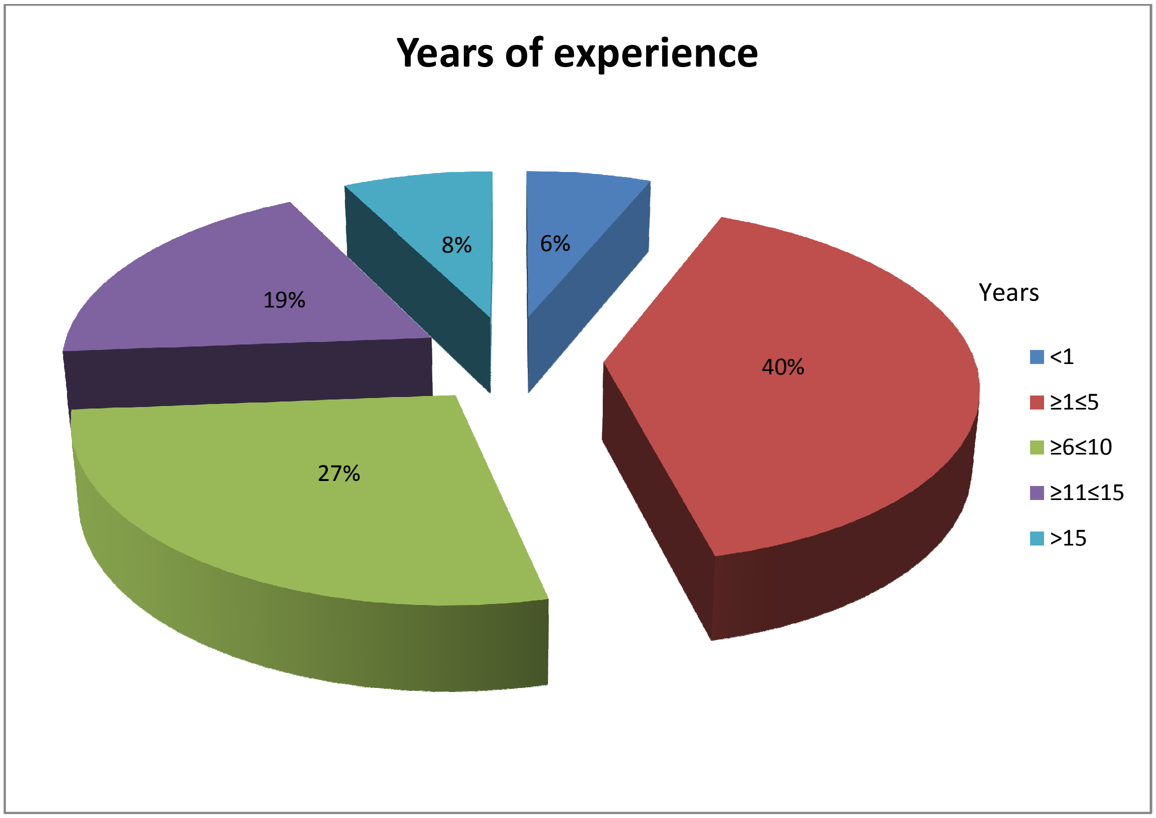


Figure 4.3 Years on the job. Source: Primary data.

4.1.4 Cause of accidents.

The findings were collated under the objective causes of accidents. The results were drawn from a sample size of 172 questionnaire responses **(n=160)**. The sample responses were evaluated under causes of accidents from different contractors and the results are shown in figure 4.4 below.

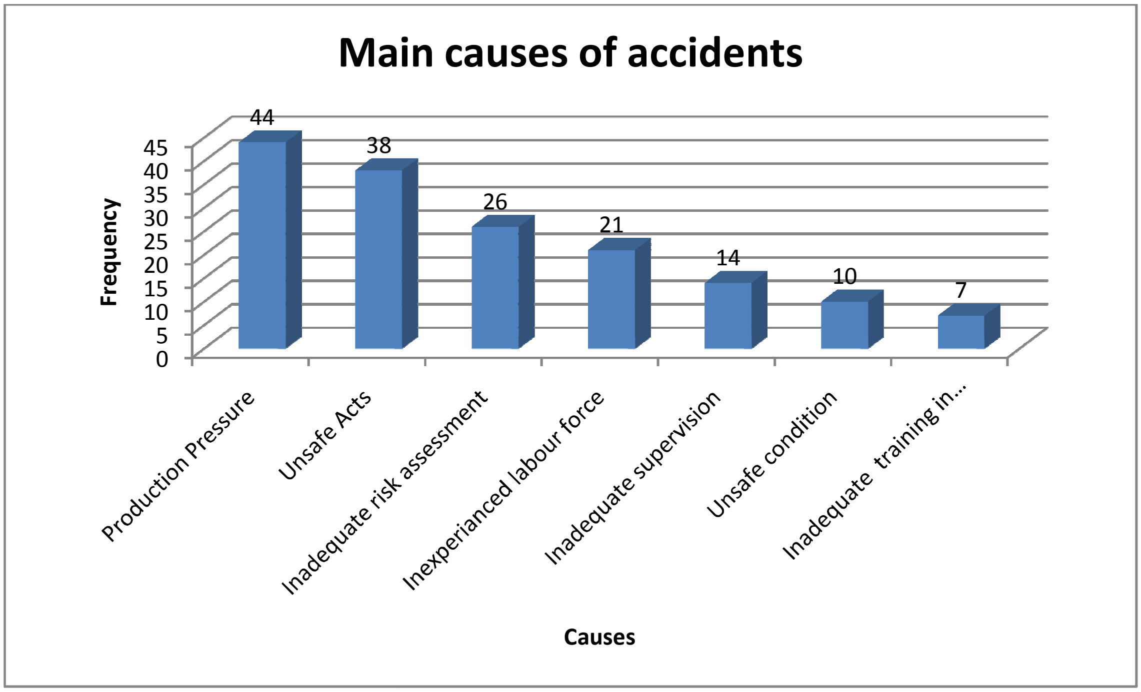


Figure 4.4 Causes of accident. Source: Primary data.

The major causes of accidents are production pressure, unsafe acts, inadequate risk assessment and inexperienced labour force as shown by the Figure 4.4 above. This outcome confirms the Human factor theory which states that overload amounts to an imbalance between person's capability at any given time and the load that person is carrying in a given state. When task load demands reduce the copying capacity of person accidents normally happens. The results shows that there is pressure to meet targets especially engineering guys because daily meetings are done to review gaunt charts to monitor progress. In Australian coal mines contractors work long hours and unstructured patterns which had led to fatigue and seriously adverse impacts to safety in order to meet production targets (Kathryn, 2002). This also supported by HSE (2003) which postulated that in North America increased levels of production pressure at coal mines resulted in increased lost time injury rate.

In additional, a variety of pressure such as to meet deadlines, peer pressure and budget factors can lead to unsafe behaviour. According to figure 4.1 above the second highest is unsafe acts or unsafe behaviours. The production pressure and unsafe acts are showing a causal relationship. Employees can take short cuts to meet the production levels. In America at Kitchenware Manufacturing Company the production personnel ended up removing safeguards from their machines in an attempt to speed production (Goetsch 1998).Apart from that, a retrospective review of data on occupational injury statistics of contractors for 2012 and 2013 was done and the table 4.3 below shows the statistics and major causes of accidents.

Table 4.3: Occupational injury statistic

Year	No. of accidents	Total Injury Frequency Rate	Major causes
2012	45	3.16	➢ Inadequate risk assessment ➢ At risk behaviour/unsafe act ➢ Inadequate supervision ➢ Inadequate training ➢ Unsafe condition. ➢ Lack of experience
2013	36	2.67	

Source: Zimplats contractor statistics 2014.

These statistics shows that contractors are contributing significantly to the injuries at Zimplats and there is a total system breakdown among contractors. During interviews with the Contractor Management and Zimplats Engineers and SHEQ Officers they issue of experience came out and failure to identify risk associated with their work and how to control them. The young skilled personnel and semi-skilled workers take short cuts to achieve a desired goal and some are still new to the harsh mining environment. Marrying with figure 4.3 it shows 46% of the total contractors have got 5 years and below in terms of experience on the current job compared to 8% with vast experience those with 15 years and above. This is supported by Mutetwa (2012) thatis in 2007 and 2008 critical staff left the country because of serious economic hardship which resulted in young inexperienced workers manning production. The young and inexperienced labour force coupled with production pressure and inadequate OSH training impacts negatively on OSH management system of contractors.

4.1.5 OSH Performance

Using the Deming's cycle (Plan – Do – Check – Act) of continuous improvement, the data for contractor performance was assessed basing on Planning Clause 4.3 and Operational control clause 4.4.6/7. Data was collected from pre-task risk assessment; Visible felt leadership and Planned job observations.

4.1.5.1 Behaviour based safety

The results shown here were drawn from a sample size of 172 questionnaire responses (n=160) from contractors. 65% indicated that they are knowable about Behaviour based safety and its benefits in accidents reduction. 34% they were not sure because not even one peer to peer observation was done on them and 1% does not know as illustrated in Figure 4.5 below. According to Muchiriri (2009), behaviour based safety is about promoting safe behaviours at work because behaviour turns systems and procedures into reality. On their own, good systems do not ensure successful health and safety management, as the level of success is determined by how the organizations 'live' their systems.

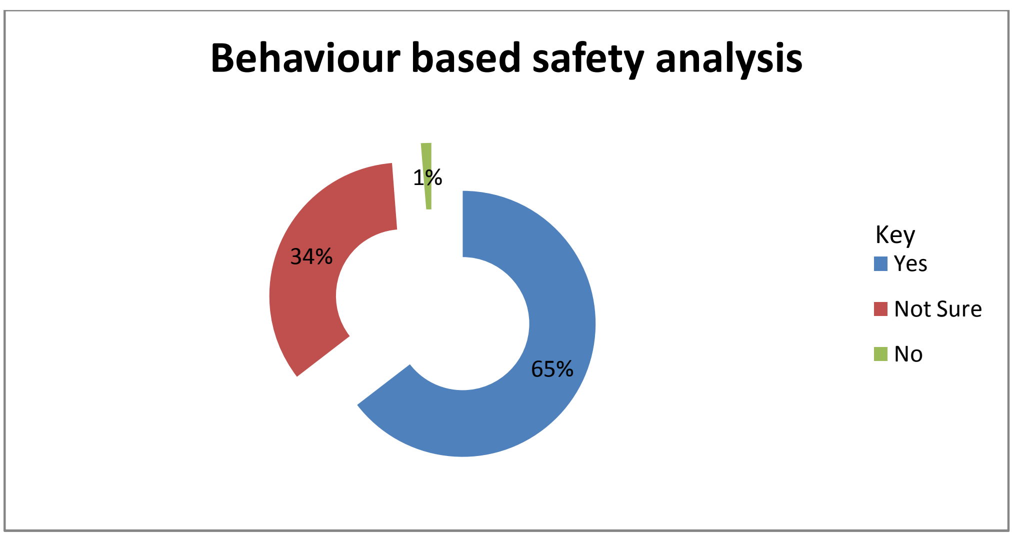


Figure 4.5 Behaviour based safety analysis. Source: Primary data.

A system of ongoing observations and feedback, typically for peer to peer observations and employee driven combined with positive verbal feedback, information collection and problem solving to improve the identified behaviours and the management system that produced them. This information will help to identify corrective actions and address them amicably.

4.1.5.2 Planned job observation and Visible felt leadership

Figure 4.6 below shows that most of contractor management do not carry out Visible felt leadership and planned job observations for their employees. Out of 160 responses 129 were not observed and coached carrying out their tasks. Which means 80% of the total population was not observed by management. On planned job observation, 66% of the total population was not observed. According to OHSAS 18001, managers should provide visible demonstration of their commitment to OHS. Means of demonstration can include visiting and inspection of sites. These statistics shows that management is not visible in terms of OHS but when it comes to task/job completion they take upper hand.Leadership must realize that they have to provide the role model in the company that communicates the importance of occupational safety and health throughout the organization. This is supported by Judith (2010) that leadership are aware that what they value and how they behave are the primary methods for getting a positive safety message across to employees.

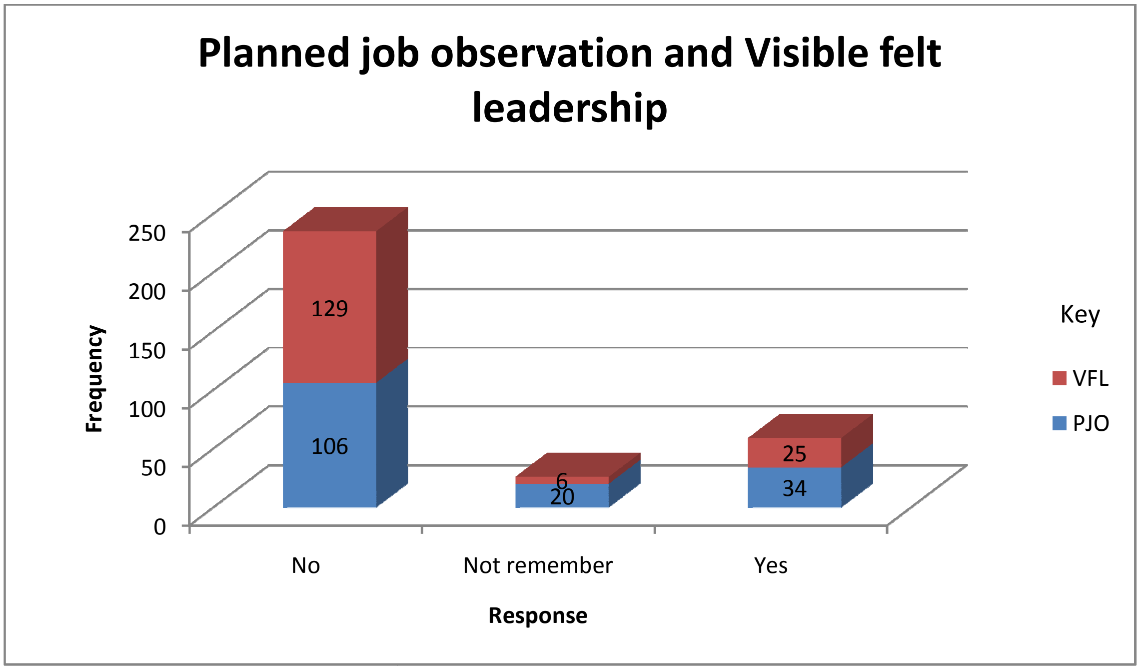


Figure 4.6 Planned job observation and Visible felt leadership. Source: Primary data.

4.1.5.3 Leading indicator – Alcohol statistics.

Zimplats platinum rule number one states that no one is allowed to enter the mine premise under influence of alcohol. Random alcohol test are done at the gate/main entrance to the mine. Anyone find positive to alcohol is send back home and face disciplinary action. This is supported by Mining (Management and Safety) Regulations, Statutory Instrument 109 of 1990 section 294 sub-section (2) which that states any person who enters a mine or is found anywhere at any working place above or below ground in a state of intoxication or of apparent intoxication shall be guilty of an offence and shall be immediately removed from such working place by the responsible official or by the manager. Alcohol statistics on figure 4.7 indicates that 80% of contractors are found under influence of alcohol when tested and only 20% permanent employees are found intoxicated. This leading indicator shows that more contractors drink alcohol and also work under influence of alcohol. Alcohol causes impairment of vision and judgement; one tends to be aggressive and argumentative. This means that a person who is under influence of alcohol can be prone to accidents.

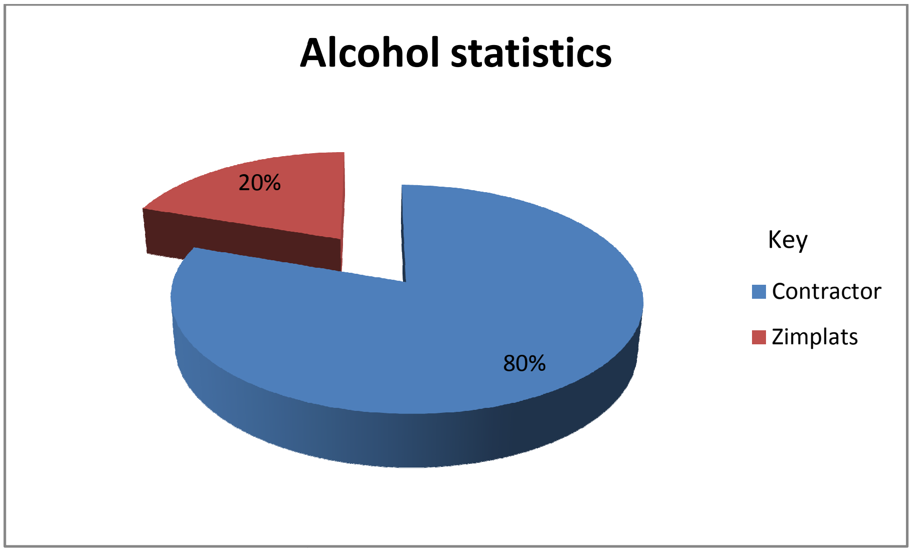


Figure 4.7: Alcohol statistics.Source: Primary data.

4.1.5.4 Leading indicator – Road behaviour observations.

Data on table 4.4 below shows observations that were done in 2013 shows that non-use of safety belts, failure to stop on stop sign and speeding are majorbehaviours of concern. These are typical at risk behaviours were someone is expected to adhere to road signs around the mine premise but prefer to break them willingly.

Table 4.4: Road behaviour observations

Offence	**Observations**
Speeding	44
No safety belt	64
Cell phone and driving	21
Fail to stop at zebra crossing	29
Fail to stop at stop sign	45
No first aid kit	7
No spare wheel/ worn tyre	1

Offence	Observations
Oil leaks	1
No reflective triangle	1
No fire extinguisher	0
Wrong parking	18
Defective lights	0
Other	0

4.1.5.5 Peer to peer observations

Figure 4.8 below indicate the statistics of peer to peer observations carried out in 2013, risk assessment non-compliance, defective/sub-standard equipment/machinery, ppe non-compliance, barricades/walkways non-compliance and vehicle non-compliance top the list. This also points to the major causes of accidents figure 4.4 above that an unsafe act is the second highest. Use defective/sub-standard equipment/machinery, ppe non-compliance, barricades/walkways non-compliance and vehicle non-compliance these add up to unsafe act or at risk behaviour. Then the third highest is inadequate risk assessment according to figure 4.4 above where by contractors fail to identify hazards and controls to mitigate or where possible to eliminate the hazard associated with the task at hand. This also point out the issue to do with training on occupational safety and health on the job and lack of experience to manage risks. Peer to peer is a management tool or leading indicator which helps to point out issues that can cause accidents and management must address issues raised to control or prevent accidents. It is also an indicator to measures performance of controls implemented after observations. This is supported by Jorne et al (1997) that reliable tools for measuring OSH performance are the leading indicators, lagging indicators and positive performance indicators.

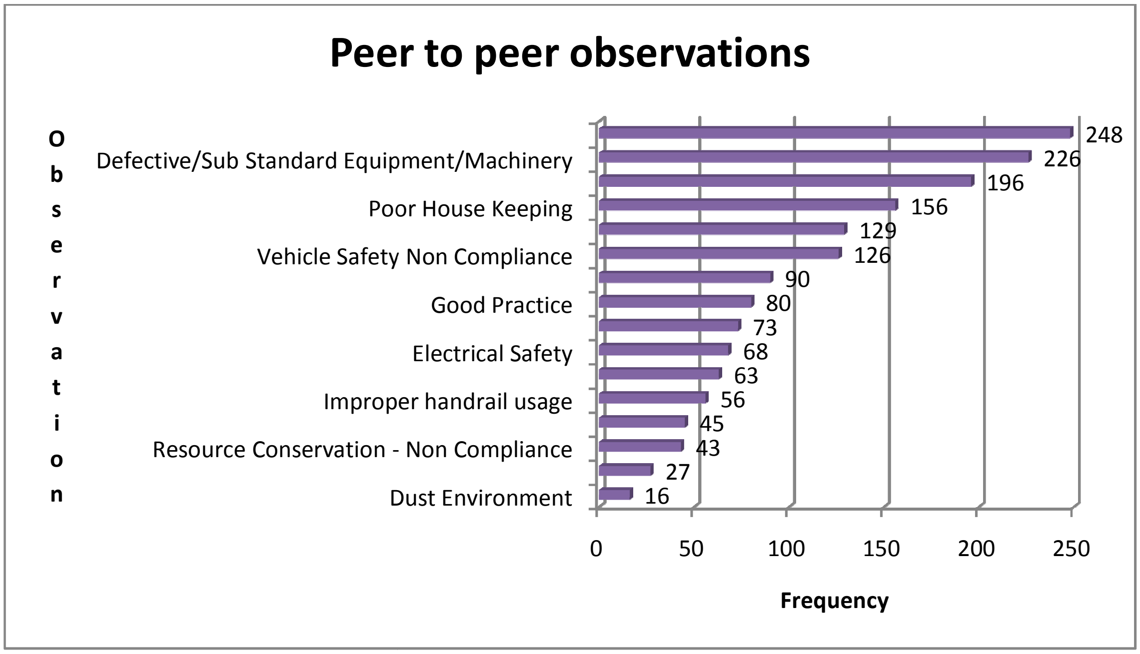


Figure 4.8 Peer to peer observations. Source: Primary data.

Peer to peer observations can be translated into statistics like coming up with percentage of at risk behaviours/unsafe observations and safe behaviours.

- % of unsafe behaviour = Number of unsafe behaviour divided by total number of observations multiply by 100
- % of safe behaviour = Number of safe behaviour divided by total number of observations multiply by 100

This calculation gives 94% unsafe behaviours and 6% safe behaviours. This data shows that behaviour change must be strategically implemented to achieve zero harm. A positive shift in percentages of observations where behaviour is safe indicates an effectiveness of the OSH management system as it is it shows there is no system in place.

4.1.6 Safety Culture and Establishment of OHS

Figure 4.9below shows the combination of assessment of safety culture and values of contractor companies. 98 respondents indicated that they were not trained on OSH on their jobs and 86 respondents do not know their parent company values. 58 respondents indicated that they do not still remember company values and 15 do not still remember receiving training on OSH. 29% acknowledge that they received on the job training on safety and 10% know company values. This shows non-compliance of OHSAS 18001:2007clauses 4.4.2 on competence, training and awareness which states that employees who perform tasks are trained and certified competent. This is also supported by Statutory Instrument 68 of 1990 which requires employers to ensure that OSH training programmes are established and employees attend these OSH training programs. Building and maintaining of effective safety and health culture requires making use of all available means of increasing general awareness, knowledge and understanding of the concepts of hazards and risks and how they may be prevented and controlled (ILO, 2003).

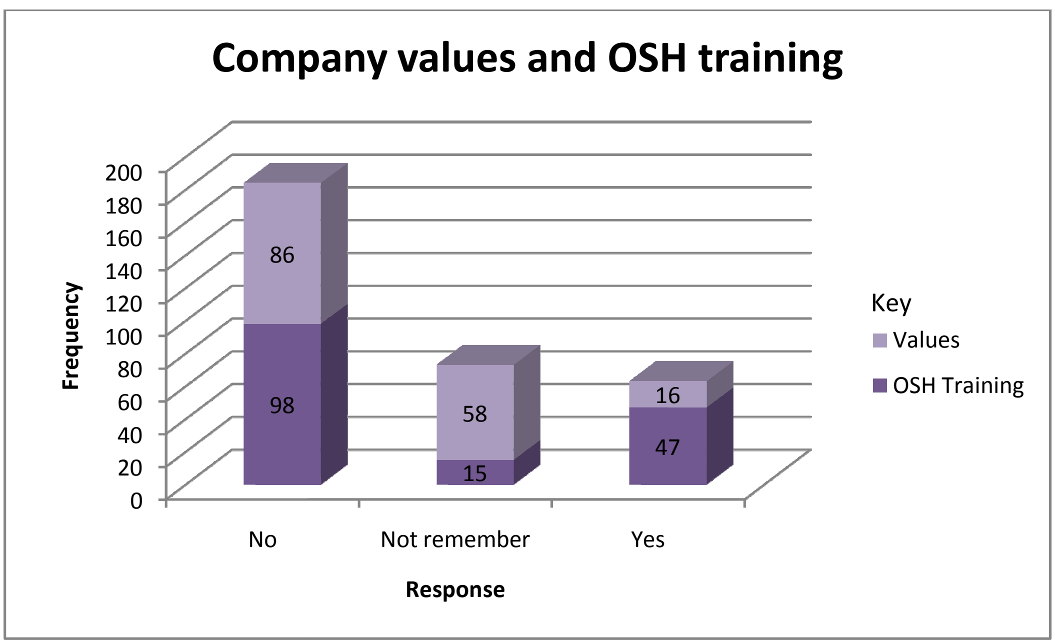


Figure 4.9: Company values and OSH training of employees. Source: Primary data.

Apart from that, when safety is a core value, employees believe that all injuries are preventable. When safety is a corporate value, companies strive for safety perfection. Companies that strive for perfection are committed to attaining zero incidents and they work to manage business operations to make it so: it's the essence of a culture of sustainable safety excellence. 10% only acknowledges that they know the values and 90% do not know that the company have values. This reflects that there is no establishment OSH management system which regards safety as a critical mission in what the company values. A point to note is that a company that walks the talk not only inscribes safety best practices into its mission statement; it also designs every task of every job so that it can be performed with as little risk-exposure as possible. It's as if their actions are saying, "Our jobs and the company's success depend on the wellbeing of one another."

4.1.6.1 Management commitment to OSH system.

Figure 4.10 below shows that 45% are not sure about management commitment to OSH management system and 35% respondents noted that management was committed to safety issues. 20% respondents said they are not committed. This is supported by an assessment that was done by NSSA in 2009 which highlighted that very few organisations have assigned responsibility for safety and health to Chief Executives and board of Directors as most of the organisations do not have any safety and health policies. Policy issues are directed by Boards and Chief Executives Officers in organisations and clearly the lack of evidence that occupational safety and health policies are reposted with Chief Executives and Board of Directors for implementation show that occupational and health is not yet tackled to satisfaction.

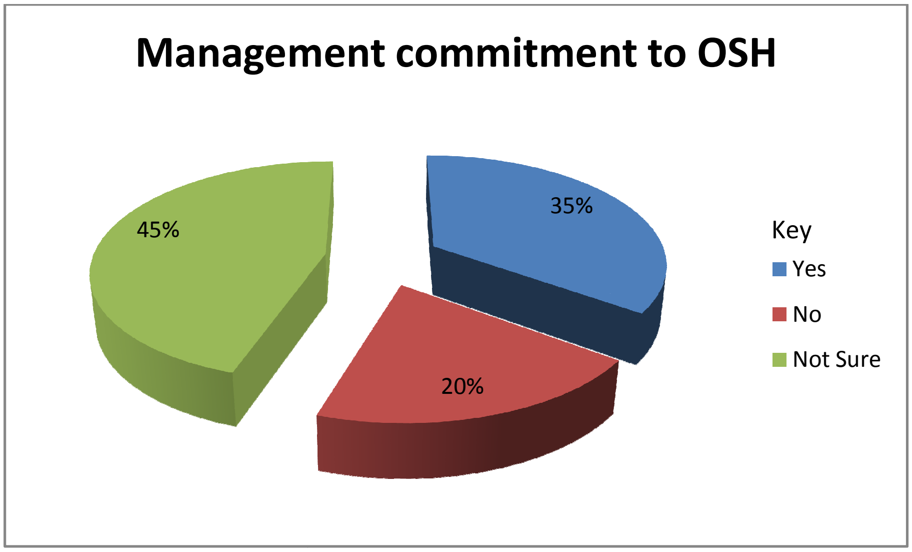


Figure 4.10 Management commitments to OSH management system. Source: Primary data.

Apart from that, a look at some organization with a good health and safety performance and culture show that management commitment is highly visible and such commitment tends to filter down to employees as the employees imitate management's attitude and perceptions towards health and safety.

4.1.6.2 Certification to OHSAS 18001:2009 management system

Figure 4.11 below shows that 49% of respondents indicated that they are not sure that the contractor company they are working for is certified to OHSAS 18001 management system. 37% of the respondents said the companies they are working for are not certified and only 14% positively indicated that they are certified. The development and implementation of sound OSH management system is critical in achieving an effective safety and health culture which should translate into recognised decrease and or elimination of occupational accidents and diseases at the workplace. The statistics translate that 86 % of the companies are not certified to any OSH management system.

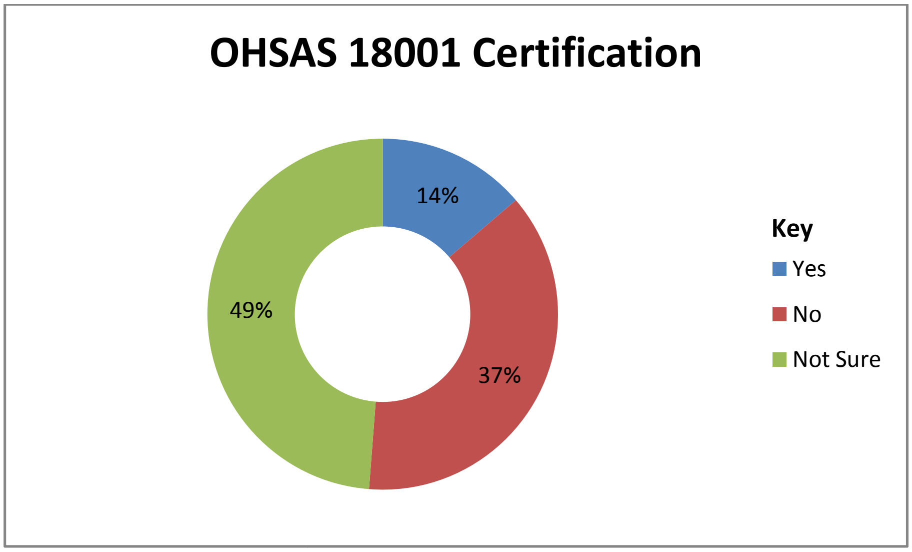


Figure 4.11 Certification to OHSAS 18001:2007 management system. Source: Primary data.

Furthermore, from the interviews conducted from 5 contracting companies only one has a certified OHSAS management system, the other four do not have a certified system. This is illustrated by Figure 4.10 below which shows that one is certified, one is working towards certification and the other three do not have a system.

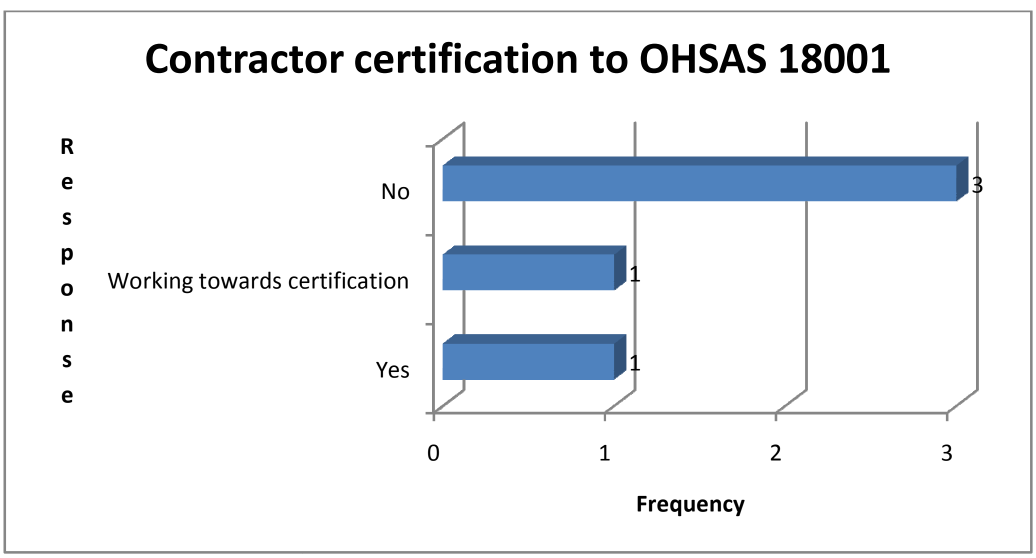


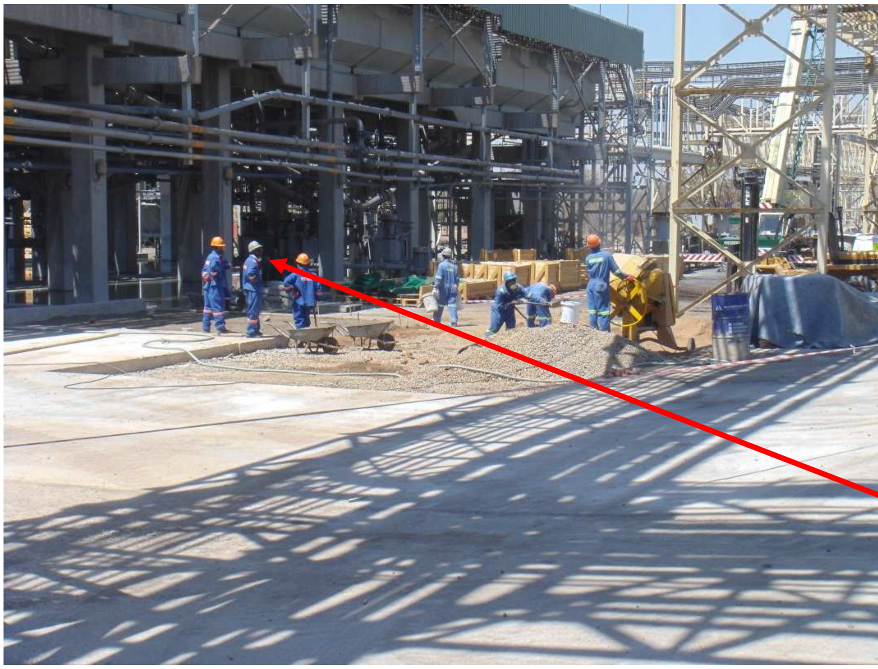
Figure 4.12 OHSAS certification. Source: Primary data.

4.1.7 Contractors'OSH management system compliance.

Observations were done and photographs taken to assess compliance levels of ppe requirements, pre-task risk assessment and short term interval control of pre-task risk assessment.. A point to note is that pictures do not lie; this philosophy should not be meant to embarrass anyone but to trigger positive action. Plate 4.1 to plate 4.5 shows different scenarios of contractors working at different workplace. It shows compliance to ppe and non-compliance as commented below on each picture

All contractors are adhering to ppe required to work at heights e.g. safety harness.

Plate 4.1: Contractors working on the sag mill. Source: Primary data.



Not wearing a dust mask

Plate 4.2: Contractors doing civil work. Source: Primary data.

Crane lifting a sag mill. Sag mill's weight is a third to the capacity of a crane. Safe way of lifting heavy weights.

Plate 4.3: 600t Crane lifting sag mill.Source: Primary data.

Plate 4.4: Contractors working on a bunker.Source: Primary data.

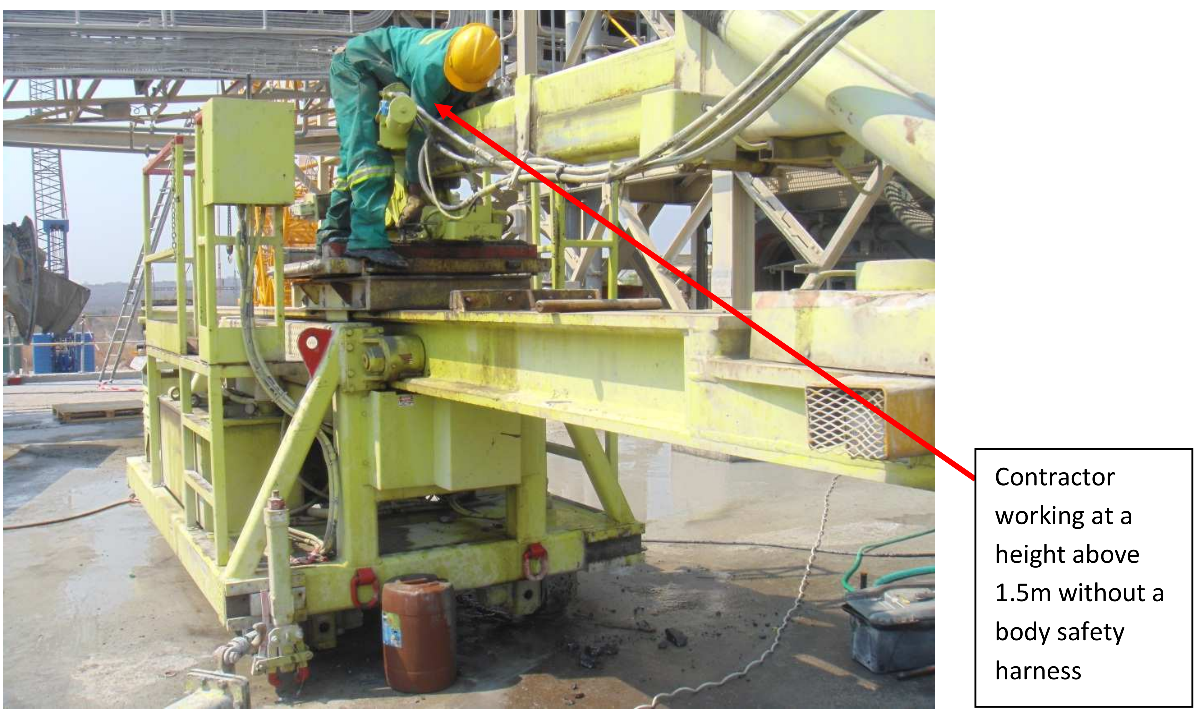


Plate 4.5: Contractor repairing a liner machine.Source: Primary data.

The responsible line supervisor must ensure that pre-task risk assessments are done and all the affected parties are informed of control measures to be taken. The supervisor is supposed to comment on the pre-task risk assessment and add additional hazards and controls if any. During observation 30 pre-task assessment forms were sampled and out 30 only 5 were done short term interval control by contractor line supervisor or management. Most of the jobs were ranging from high risk to medium jobs. This shows non-compliance to OSH management system under operational control clause 4.4.6 and Zimplats procedure BMSP 4.3.1 section 6.2.4 stipulates that line supervisor/section head/manager shall carry out short term interval control. This is a second eye which will help to identify other hazards which could have been missed by the team. Figure 4.11 below shows that 83% of pre-task risk assessment were not assessed by managers which might translate to significant workforce having inadequate risk assessment and they are likely to be injured. Linking this with figure 4.4 above on major causes of accidents, inadequate risk assessment is one of the highest causes. This also points out that management are concerned with production or completion of tasks/jobs and not safety of their employees. Furthermore it leads to an issue of safety culture which is not displayed by the management.

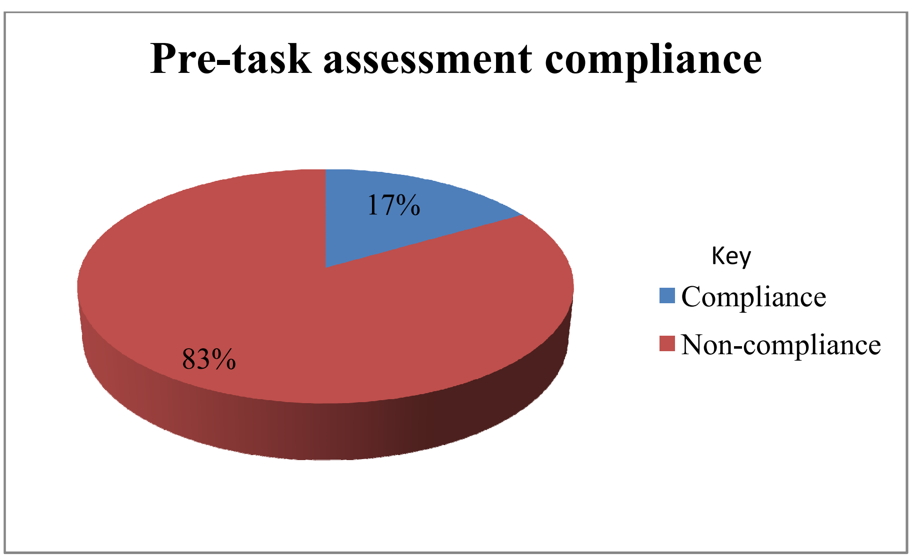


Figure 4.13 Pre-task assessment short term interval control compliance.

According to Bellamy and Geyer (2007) the dominant safety management system failures are mainly failed risk identification, competence, and communication failures. Line managers are regarded as competent personnel and their failure to help in continuous risk assessment shows system failure to take a pro-active approach to management of hazards at the workplace.

4.2 Discussion

Figure 4.1 and 4.3 clearly show that the contractors' workforce is characterised with young and inexperienced workforce. Some of the workforces are fairly coming from school and college. Only 8% have got above 15 years of experience compared to 46% which is below 5 years of experience. This also point to fact that the workforce is still 'green' they lack experience and exposure to harsh mining environment. These pose a risk in managing hazards at the workplace because they still want to learn and experiment. Even if the contractor tries to blend the experienced and unexperienced the ratio will become unmanageable.

Such high frequency accidents for 2012 and 2013 shown in table 4.3 were observed to be mainly caused due to production pressure, unsafe acts, inadequate risk assessment and inexperienced labour force. These results reflect serious lack of a safety and health culture in almost all contractors. In additional to that, scrutinising the peer to peer observations issues that were coming out are risk assessment non-compliance, use of defective/sub-standard equipment/machinery, non-compliance to ppe requirements, barricades/walkways non-compliance and vehicle non-compliance. Lack of proper hazard identification and assessment processes pointed out as one of the main cause of accidents and in peer to peer observations means there are no hazard profiles in almost all jobs done by contractors'. Which means that it is difficult for workers to appreciate what hazards could affect them. All this issues point out to lack of clear and effective policies on OSH. Furthermore, the researcher established that there is no meaningful OSH systems were identified in contractors' evaluated and as such, this could be having a major contributing factor to accidents.

Apart from that, figure 4.7 indicate that 98 out of 160 respondents did not receive training on OSH on the job. For employees to demonstrate knowledge and understanding of the hazards associated with their work they need to be trained. Employees need mandated periodic training as well as training when new processes, chemicals or equipment are introduced or when they are transferred to new locations or department.

Out of 5 contracting companies one company has got a certified OHSAS 18001 management system and the other four do not a system in place. They do not have OSH policy which means safety it's just a window dressing issue. This also evidenced by hiring services of SHE Officers and taking student on attachment to work as SHE Officers to save money. There is lack of OSH structures like safety and health committees and budgetary provision for OSH programmes giving rise to a poor safety and health culture. The company values are not known, only 10% are aware of the values and the top management is not visible to demonstrate that they care about employees' warfare at work through carrying out visible felt leadership, planned job observations and short term control intervals.

In summary, the hard (elements that deal basic safety functioning) and soft (elements that deal with culture) skills are not addressed as shown above which resulted in poor OSH performance and the efficacy of the system is highly questionable to address high rate of accidents and at risk behaviours.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In view of the results obtained, it is crystal clear that the contractors' occupational safety and health management system is not operating effectively but they are riding on the back of the parent company. To those contractors that are certified to OHSAS 18001:2007 management system is not fully implemented as per-system requirement.The study has revealed that the issues picked through performance indicators that is leading and lagging as part of OSH requirements were not addressed through training and accident recall. These issues can also be tracked and addressed by carrying out planned job observations, visible felt leadership and short term interval control of which this is not happening to close the gap. These preventive programmes at the workplace arenot well implemented and establish resulting to high rate of accidents. Leading indicators are proactive in approach such that embedding their implementation and reporting would result in the reduction and prevention of accidents.The problem with contractors' are focused much on lagging indicators which is the accidents and their investigation rather than on leading indicators.Tracking leading indicators would consequence in accident prevention than is the case now.

One key issue to note from the studyis that top management involvement in occupational safety and health issues is quite limitedimplemented, hence poor occupational safety and health performance. Thus governance of occupational safety and health risks is quite limited and largely ignored by senior management of contractors. There focus is on production and operations without necessary seeing how occupational safety and health is an integral part of production.The provision of role model by leadership in the company that communicates the importance of occupational safety and health throughout the contracting companies is not seen or felt.

Findings indicated fundamental OHS deficiencies such as risk identification, assessment and control; worker participation, consultation and communication on OSH issues and OSH training. The defects are an indication of management lack of commitment impacting negatively on system effectiveness.Employees are not aware about the company values which means there is no culture within the company or the culture is not defined. An important point to note is that management commitment to OSH and employee participation, empowerment and involvement are critical aspects of any safety and health culture. This also yields proactive positive attitudes and behaviours towards OSH which leads to better management of risks. Furthermore, OSH training on the job is very low among contractors as shown by figure 4.7 above,only 29% are trained, 10% do not remember receiving any training and the largest percentage have not received training that is 61%. According to OHSAS 18001:2007clause 4.4.6 and 4.4.1 standard requirement is to make sure that the organization ensure that any person(s) under its control performing tasks that can impact on OH&S is (are) competent on the basis of appropriate education, training and experience. Which means that the employees who were not trained in standard operating procedures and risk assessments are a risk factor at the mine and may actually result in an accident? This supported by ILO Convention No. 174 (Article 9); With regard to employers' responsibilities, the Convention lays down that employers shall provide "organizational measures, including training and instruction of personnel, the provision of equipment in order to ensure their safety, staffing levels, hours of work, definition of responsibilities, and controls on outside contractors and temporary workers on the site of the installation.

Apart from that, causes of accidents were found to be production pressure was the major cause of accidents followed by unsafe acts, inadequate risk assessment and inexperienced labour force.Findings highlighted the relegation of OSH and prioritization of production, ahead of safety. It is the duty of management to address safe production not production first and provide training from issues raised from accidents investigation and leading indicators.In assessment of these findings it was concluded that causes of accidents were generally springing from management actions and commitment on OHS management system.

Considering the above, it was therefore concluded that the contractor OSH management system was not sound in preventing and reducing accidentsand at risk behaviours at workplace.

5.2 Recommendation

In reflection of the foregoing observations, discussion and conclusion it is recommended that:

- Management to show commitment in minimizing risks in the operations and complying with all relevant safety and health issues. Management to accept the responsibility for safety and health and be role models. They must willingly become involved in safety and health and change their attitudes to risks. It is also critical that the management put in place sound OSH management systems for any positive safety and health culture to be achieved.

- Management to rationalize OSH and competence training at all levels and conduct such trainings regularly to contribute to a safety culture. Obligatory OHS training such as risk identification, assessments and control and operational procedures for all employees as required by the OHSAS 18001 system would be given priority.

- Since the principal company have got sound OSH management systems, the on-site training of safety and health practices must be harmonize to accommodate contractors. In house training should aim to ensure that both the contractor and the principal company have the same level of knowledge. When the company organizes such training, it should incorporate its contractors.

- Method statements and risk assessments documents to be produced by the contractors' before commencement of work this shows commitment to safety and health practices and it's a good starting point for introducing a safety culture. These documents shall be produced in consultation with the principal company. The contractor has to make several visits to the expected project site, assess the area, and discuss potential risks and ways of mitigating them with the relevant personnel of the principal company. The principal will then approve the risk action plan as satisfactory for reduction risks to As Low as Reasonably Practicable (ALARP), and check that it is in agreement with its safety and health management system. These identified risks and their controls should be in cooperated in pre-task risk assessment and also be part of training to contractor employees who are going to carry out the job.

- Contractors' and principal company safety systems can also be harmonized through Job Hazard Analysis (JHA). Any activity that the risk assessment ranks as posing medium or significant risks, a JHA must be done and reviewed by both parties. This will help to manage risks that are associated with task/job and also closing the gap of inadequate risk assessment as one of the major cause of accidents.

- Management to review daily production target and the commensurate labour to ease pressure on employees. The Gantt chart of jobs must proportionate with labour so that targets will be realistic. Failure to achieve these targets results in panic and shortcuts to compensate unachieved target. A review of this will relieve pressure on the workforce and discourage short cuts.

- The principal company should carry out contractor assessment and benchmarking. Assess the safety and health practices before engagement, and continually audit them after engagement. This can be done through site visits to the workplace or project area, or through document review. Engagement should be done when satisfied that the standards are adequate. Periodic assessments are also important to be done because they keep contractors committed to the OSH management systems.

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Appendix 1

Appendix 1: Occupational injuries for the period 2004 to 2009 for mining and quarrying and other selected high risk sectors.

SECTOR	Year/Injuries						Total	Average for 6 Years
	2004	2005	2006	2007	2008	2009		
Basic Metal Production	949	908	631	569	478	268	3803	633
Metal Fabrication	920	703	672	488	282	276	3341	556
Mining and Quarrying	1094	959	663	550	351	269	3886	648
Wood and Wood Products	499	392	402	322	57	139	1811	302
Transport and Storage	780	605	542	380	262	320	2889	481
Forestry	221	200	121	63	55	31	691	115
Agriculture	1118	774	764	401	246	14*	3317	553

Appendix 2

Appendix 2: Questionnaire for contractors

Your answers to this questionnaire will be **CONFIDENTIAL** and will not be given to anyone else without your written permission. The purpose of the questionnaire is to evaluate the effectiveness of contractor occupational health and safety management system in achieving zero harm. Your honest and quick response will be mostly appreciated. Thank you in advance. – L. Karikeka – Safety, Health, Environment and Quality Officer.

Please answer the following questions by placing a tick (□) next to the answer that best suits your opinion where necessary.

Section A: Respondent details

Section A: Respondent information

1. Gender

Male	1
Female	2

2. Age group in years

<21	1
21-30	2
31-40	3
41-50	4
>50	5

3. Level of Education

No schooling	1
Primary education	2
Secondary education	3
Tertiary education	4
Post graduate	5
Others (specify)	6

4. What is your position?

   ……………………………………………………………………………………

5. How long have you been working?

<1year	1
1-5 years	2
6-10	3
11-15	4
>16	5

Section B: Causes of accidents

6. Within your work station, what do you think is the cause of accidents? (Please tick on box)

Cause	√ **Tick**
Unsafe acts	
Unsafe condition	
Inadequate risk assessment	
Inexperienced labour force	

Production pressure	
Inadequate supervision	
Inadequate training in Occupational safety and Health.	
Other cause (please specify)	

7. In your own opinion why did you choose the above cause of accident? Give examples if any.

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

8. Are employees getting injured because they do not know how to work safely?

Yes	No	Not Sure

9. If No, what can be done to prevent accidents?

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

10. Is it important to carry out a pre-task risk assessment?

Yes	No	Not Sure

11. If Yes in your opinion demonstrate where it helped to prevent/reduce accidents in your work area?

…………………………………………………………………………………………

…………………………………………………………………………………………

……………………………………………………………………………………………

12. In your own opinion why are risks assessments failing to prevent accidents?

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

13. Are you empowered to stop unsafe condition?

Strongly agree	Agree	Neutral	Disagree	Strongly disagree

Section C. OSH performance and effectiveness.

14. Do you know about behaviour based safety or peer to peer?

Yes	No	Not sure

15. If Yes what does it do you?

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

16. Have you ever been observed or a Planned Job Observation carried out whilst you were doing your task?

Yes	No	Do not remember

17. If Yes what were you told about it?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

18. In your opinion what do you think about planned job observation?

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

19. Have you been observed or coached (Visible Felt Leadership) by your supervisor whilst working?

Yes	No	Do not remember

20. What were you told?

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

21. What's your opinion?

………………………………………………………………………………………………………

………………………………………………………………………………………………………

Section D: Safety Culture and establishment of OHS

22. Did you receive Occupation Safety and Health training on your job?

Yes	No	Not Remember

23. If yes do you think the training will help to reduce accidents?

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

24. Do you have values as an organisation which you are working for?

Yes	No	Not Remember

25. If Yes state them.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

26. In your opinion, is management at all levels committed to occupational safety and health in achieving zero harm?

Yes	No	Not Sure

27. If No, in your opinion where is the problem?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

28. Do you believe Zero Harm is achievable?

Strongly agree	Agree	Neutral	Disagree	Strongly disagree

29. If Yes in your opinion what do you think must be done to achieve Zero Harm?

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

30. Is your company certified to OHSAS 18001:2007?

Yes	No	Not sure

31. In your own opinion is there full involvement of contractors in Occupational safety and Health issues and programmes?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

32. What do you think about Occupational Health and Safety Management system about your organisation?

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………………………………………………………………………………………

………………………………………………………………………………………

Thank you

Appendix 3

Appendix 3: Interview guide for contractor management/site Forman

Company:

Date:

1) What is your core business?
2) How many employees do you have?
3) What are the levels of manpower at pick and off pick?
4) How many years have you been providing services to Zimplats?
5) What safety and health management system do you have in place?
6) How effective is the system?
7) What is your safety record?
8) Do you have a safety Officer?
9) What is the level of qualification of a Safety Officer?
10) How are you managing OSH management system requirements?
11) What challenges are facing in managing safety and health issues at Zimplats?
12) What do you think must be done to close the gap?

Appendix 4

Appendix 4: Interview guide for Section or Operations Engineer.

Department:

Date:

1) How do you choose a contractor?
2) Who are your contractors you have used to do your work?
3) What do you do with new contractor who wants to do a job for you?
4) How do you manage the change in contractors?
5) How do you ensure they do your work as per your plan?
6) How have your contractors performed safety wise at:
    i. Zimplats.
    ii. Elsewhere.
7) What are the challenges you are facing with contractors?
8) Why incidents/accidents and at risk behaviour very high which involve contractors?
9) How can we close the gap?

Appendix 5

Appendix5: Interview guide for SSD Manager/SHEQ Officer.

Date:

1) How many years have you being working at Zimplats?
2) What is your experience with contractors?
3) Why mostly accidents happen among contractors?
4) What are the unsafe behaviours that you have observed from the workforce that is causing accidents?
5) What can be done to improve this scenario?
6) How effective is OHS management system among contractors?
7) What is the compliance level of contractors in managing safety as per Zimplats expectation?
8) When did you last carry out safety audit on your contractors?
9) What were issues coming out of the audit?

Appendix 6

Appendix 6: Interview guide for contractor SHEQ Representative/Officer

Company:

Date:

1) What is your experience working with contractors?
2) What is your Level of qualification and experience in SHEQ issues?
3) What does the Zimplats contractor management entails?
4) What do think are main causes of at risk behaviours and accidents involving contractors?
5) How can these undesirable events be managed to achieve zero harm?
6) In your opinion how effective is your OSH management system?
7) How can we close this gap?

Appendix 7

Appendix 7: Observation guide

Date of visit:

1) Walk through the operation/process.

2) Observe all the processes taking place.

3) Take note of all unsafe acts and conditions.

4) Check pre-task risk assessments done and check compliance.

5. Check weather employees are adhering to the prescribe ppe and take pictures.