KYAMBOGO UNIVERSITY

FACULTY OF ENGINEERING

IMPACT OF INVESTMENT IN OCCUPATIONAL HEALTH AND SAFETY ON A STEEL MANUFACTURING PLANT IN UGANDA

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DECLARATION

I declare that this master's dissertation is my original research idea which has not been submitted anywhere for research and has been properly referenced and acknowledged in accordance with the requirements of the Kyambogo University.

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APPROVAL

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LIST OF ABBREVIATIONS

OHS	Occupational Health and Safety
GDP	Gross Domestic Product
ILO	International labour Organization
WHO	World Health Organization
ASSE	American Society of safety engineers
OSHAS	Occupational Health and Safety Assessment Serries
SPSS	Statistical package for social sciences
SDG	Sustainable Development Goal
DOHS	Department of Occupational Health and Safety
ISO	International organization for standardization
SSE	Sum of squared Errors
SSR	Sum of Squared Regression
SST	Sum of squared Errors

DEFINITION OF TERMS

Health is a condition of total physical, emotional and social well-being and not simply the absence of sickness. Health in the workplace means the promotion and maintenance of physical, mental and social wellbeing of workers, prevention of ill-health caused by the working conditions of workers, protection of workers in their employment from risk resulting from factors adverse to health, placing and maintenance of the worker in an occupational environment adapted to his physical and psychological equipment.

Safety identifies, evaluates and controls workplace hazards. Safety involves measures, methods or techniques or process to prevent human exposure to unsafe work practices and physical or even chemical agents. Safety in the workplace may involve improving working conditions and safe methods of work, reasonable hours of work, provision of personal protective equipment and provision of first-aid and medical facilities.

Welfare is provision of services and facilities to protect the health and well-being of employees at the workplace.

Accident is an unintentional, unexpected and unwanted occurrence that interrupts the orderly progress of work in an establishment by causing bodily injury to a person making him unfit to resume duty due to partial or total disablement or even death. An accident can also cause damage or loss to property, plant, materials or the environment.

Near miss is any occurrence that may have resulted into an accident. It is estimated that a small incident would occur for every ten 'near miss' incidents at a certain location in the workplace, a minor accident will occur.

Hazards are potential conditions that would result into an accident. It is a condition that has the ability to harm a person or impair one's health.

Risk is the possibility of a substance, process, or activity to cause harm**.**

ABSTRACT

The subject of health and safety of workers in the steel manufacturing sector has become a concern of recent mainly in developing countries. The study therefore sought to investigate the impact of investment in health and safety on steel manufacturing companies in Uganda, a case study of Roofings Rolling Mills in Namanve Industrial area. The aim of the study was to identify the different health and safety preventive measures that have been put in place, examine the costs associated with OHS measures and work-related incidents, determine the qualitative and quantitative benefits of the OHS intervention measures and finally find out how health and safety affect the employee's productivity using regression analysis. A descriptive survey study was adopted as the research design. Review of incident cases registers, hazard identification and risk assessments forms, employee compensation claims, records for lost workdays was done. Simple random and judgmental sampling techniques were used to select subjects from each plant to give data on how health and safety affect the productivity measures of quality, work output, attendance and one's morale. The data on productivity measures, accident prevention costs, accident costs was analyzed both qualitatively and quantitatively using the IBM SPSS VESION 26 and Microsoft excel. The findings of this study show remarkable reductions in injury numbers, lost workdays, and this translates into low injury costs and this is linked to be direct benefits of occupational safety and health measures. For every one percent increase in OHS measures, the benefit in terms of reduction in direct injury costs is between 2 to 8 percent and this was consistent with other studies. From the coefficient estimates of regression analysis, both work quality and quantity increase by 76.6 percent, the morale of employee increases by 76.7 percent while the attendance improves by 76.2 percent. The marginal increments in the productivity measures due to a unit increase in safety are; 27.6 percent for one's presence, 28.2 percent for work quality, 28.3 percent for individual's work output and 26.8 percent for one's morale. The coefficient of determination (R square) is 0.49 which shows that productivity is 49 percent influenced by the health, safety and the rest 51 percent is explained by other factors which were not considered in the study.

The findings help the employer not to look at the expenditure associated with OHS measures as a cost but rather as an investment with return and not to make decisions on whether any changes will bring cost saving but whether it will protect workers. The findings will help the organization to reduce the levels of risk at different plants.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter covers historical trends and background of occupational health and safety globally and in Uganda mainly in steel manufacturing plants. It further highlights the problem that was addressed in the study, the objectives of the study, the guiding questions for the study, geographical and subject scope, justification and the significance of the study for a steel manufacturing plant.

1.1 Background to the study

Occupational Health and Safety (OHS) is a vital aspect of the workers wellbeing in the workplace that entails protecting the health, safety, and wellbeing of employed individuals at the workplace such that no harm befalls them. According to the World Health Organization, Occupational Health and Safety is an interdisciplinary activity that is grounded on four basic facets namely; protecting and promoting the workers' health, developing and promoting a safe and healthy working environment, enhancing social, physical, and mental wellbeing of employees, and workers' capacity to lead economic and socially productive lives that contribute positively towards sustainable growth and development. (WHO, 1995). Working in an iron and steel industry is considered to be dangerous as some steel working processes are hazardous. The dangers in an iron and steel industry include pouring of molten metal or slag, furnace charges, gas explosions, movement of locomotives and wagons, cranes, ladles, other loads and falling of heavy objects (Mazeheri et al., 2009). OHS target an adaptation of the working environment to employees to promote and sustain the utmost degree of employees' mental, physical, and social wellbeing in all occupations (Takele & Mengesha, 2006).

Occupational Health and Safety (OHS) issues have been present since the advent of human labor; but a definite approach to the management of occupational diseases came to be more legitimate in most countries in the 20th century; Moreover, noticeable improvements have been made in the health care of workers in the domain of occupational hygiene and safety in developing countries.

In addition, International Labour Organization (ILO) has continually supported the international community in executing their mandate of protecting workers against occupational diseases and injury (WHO, 2010). According to National safety Council (2005), Work related injury results in loss in terms of income, productivity and medical expenses Globally it has been approximated that 960,000 or more employees get injuries and 5,330 workers die daily from work-related illnesses (Mekkodathil et-al., 2006).There are more than 2.78 million deaths recorded worldwide annually due to workplace accidents or work-related diseases. According to International Labour Organization (2019), about 374 million work-related non-fatal accidents are estimated to occur annually, resulting in up to 4 days of absence from work and 3.94 percent of GDP per year is estimated to be lost globally due to poor occupational health and safety practices (ILO, 2019).In many developing countries, workers' death rates due to workplace injuries are 5 to 6 times higher than those in developed nations but the situation remains undocumented in developing countries due to inadequate recording systems. Moreover, the World Health Organization (WHO) reports that 30% of new cases of Hepatitis B Virus (HBV) and 2.5% of annual HIV infections among health care employees in sub-Saharan Africa result from acute injuries (World Health Organization, 2002).

In Uganda, the administration and regulation of the Occupational Health and Safety Act, No9 (2006) is the responsibility of the Department of Occupational Health and Safety under the Ministry of Gender, Labor and Social development. By supporting the enforcement of OHS activities and cancelling of the factory Act (1964), the Government of Uganda has made efforts to enhance health and safety of all employees in the country. However, this has had minor impact because of poor implementation of the OHS Act (2006). Moreover, Uganda's Labour productivity is reportedly the lowest among the East African sates due to unhealthy and unsafe working conditions (Department Of Health and safety[DOHS], 2016). According to the International Labour Organization (2015), employers' underinvestment in health and safety measures in the workplace has led to increased number of incident cases of injuries, non-fatal accidents, fatal accidents and near misses in various workplaces culminating into lower productivity and reduced efficiency. On the other hand, investment in occupational health and safety (OHS) cuts down both direct and indirect costs in dealing with health and safety related issues in the workplace; notably it decreases insurance rates, minimizes absenteeism and raises worker morale hence enhancing efficiency of operations. On the national level, reduced costs of social security and health care culminate into reduced taxes, stronger economic performance and expanded social benefits (ILO, 2015). In several nations, the incident rate of workplace related accidents and injuries reportedly decreased steadily in line with the successful implementation of protection and preventive measures in the workplace. Therefore, an evaluation of the impact of investment in Occupational Health and Safety on a steel manufacturing business in Uganda is explored in this study.

1.2 Statement of the Problem

Many workers in steel manufacturing plants in Uganda are not aware of their rights to a secure and healthy working environment despite the existence of the Occupational Health and Safety Act, 2006. The workers in steel manufacturing plants have remained vulnerable to unhealthy working conditions and unsafe plants and equipment leading to ill health, workplace injuries and even deaths in some severe cases. Furthermore, the low labour productivity in Uganda in comparison to other East African states is attributed to unhealthy and unsafe working conditions in workplaces (DOHS, 2016). The International Labour Organization (2015), reports that underinvestment in health and safety measures in the workplace has led to increased incidents of injuries, non-fatal accidents, fatal accidents and near misses in the workplaces culminating into lower productivity and reduced efficiency. The World Health Organization (WHO) reports that about 20-50% of employees worldwide are exposed to different workplace hazards and the vulnerability to workplace hazards is higher in developing countries like Uganda compared to developed countries (WHO, 2014). Moreover, expenditure on occupational accidents and illnesses is usually much bigger than comprehended; Other than the economic cost of occupational accidents and illnesses, there are also intangible costs like deaths and the enormous human suffering at individual, community, and organizational levels that is not fully recognized. However, most incidents of occupational accidents and illnesses are preventable through implementation of health and safety measures in the workplace.

1.3 Objectives of the study

1.3.1 General objective

The general objective of this study is “To investigate the impact of investment in Occupational Health and Safety on steel manufacturing companies”

1.3.2 Specific objectives

The specific objectives of the study include:

(i) To determine the different Occupational health and safety measures that are in place in a steel manufacturing plant in Uganda.

(ii) To examine the costs associated with implementation of OHS measures and handling of work-related incidents in a steel manufacturing plant.

(iii) To determine the impact of implementation of occupational health and safety measures in a steel manufacturing plant.

1.4 Research Questions

(i) What are the different occupational health and safety measures that are in place in the steel manufacturing plants in Uganda?

(ii) What are the applicable costs associated with implementation of OHS measures and handling of work-related incidents in a steel manufacturing plant?

(iii) How has the implementation of occupational health and safety measures impacted the operations of a steel manufacturing plant?

1.5 Conceptual framework

The conceptual framework of this study, shown in Figure 1.1, presents the interrelationships of various categories of variables that define the Occupational Health and Safety system of a steel manufacturing plant. The independent variables comprise of investment in occupational health and safety measures in a steel plant while the dependent variables include the indicators of worker productivity and organizational performance. The indicators of investment in occupational health and safety include provision of protective equipment (clothing, tools), provision of periodic trainings on health and safety, Indicators of employee productivity include employee attendance, work output, and morale while indicators of organizational performance include compensation payouts for work-related injuries, quality of work output/ products, employee retention and employee turnover. The intervening variables include the national Occupational Health and Safety Law and the organizational occupational health and safety policy**.**

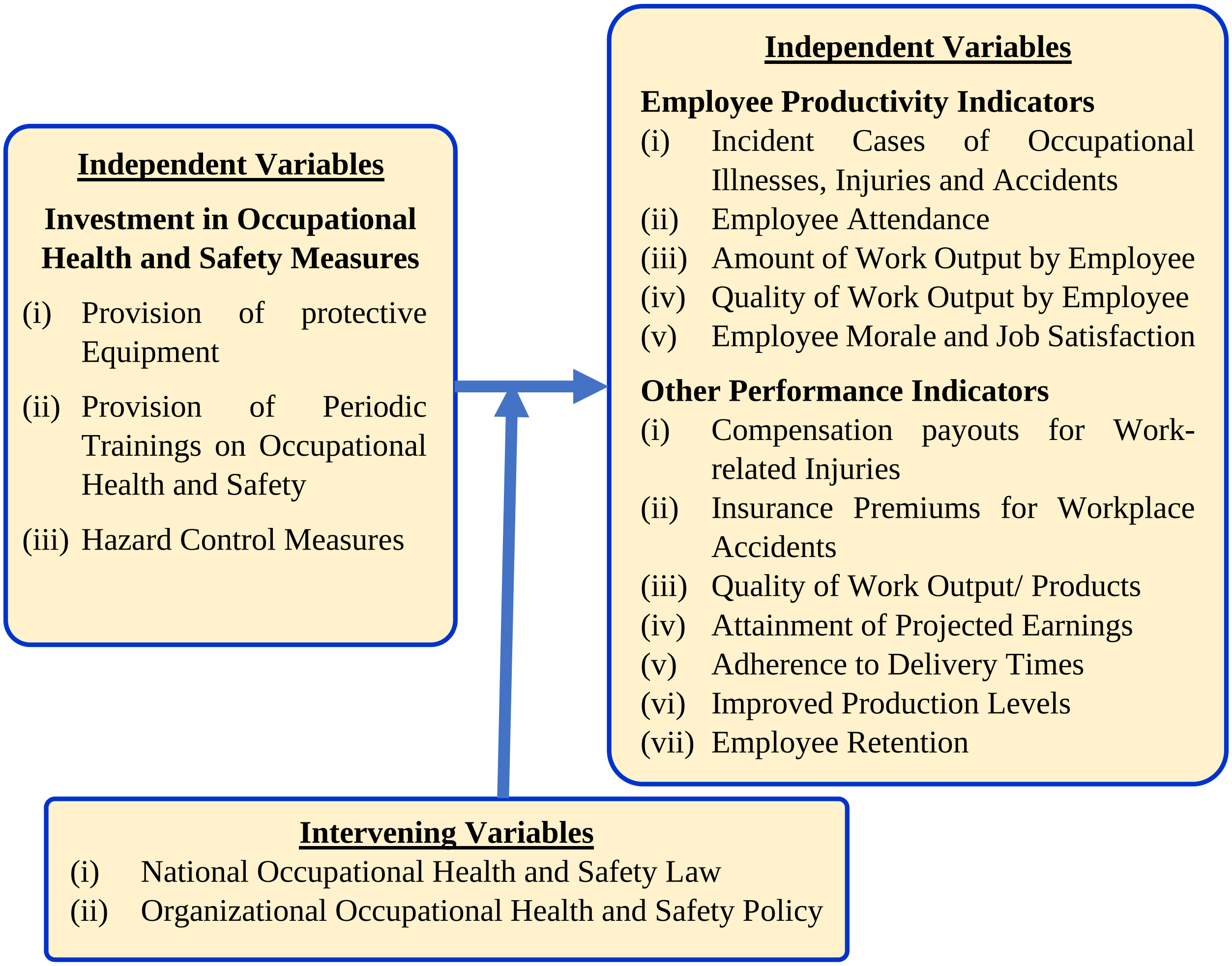


Figure 1. 1: Conceptual Framework of the study

1.6 Justification of the study

Occupational Health and Safety (OHS) is crucial to sustainable industrial development and investment in OHS can help contribute to achieving the elements of the 2030 United Nations Agenda for Sustainable Development outlined in the Sustainable Development Goals. This study is specifically aligned to contribute to achievement of Sustainable Development Goal (SDG) 3, ensure healthy lives and promote well-being for all at all ages and SDG 8, promote inclusive and sustainable economic growth, employment and decentralization (Bardhylka, 2016).

1.7 Significance of the study

This study develops knowledge in the domain of occupational health and safety in the industrial sector, the findings of this study inform employers in the industrial sector of the importance of implementing an effective occupational health and safety management. This study increases the awareness in workers in industrial sector of their rights to a secure and safe working environment and also informs the industrial employers of the qualitative and quantifiable benefits of investment in a functional occupational health and safety management system.

1.8 Scope of the study

The work reported in this study is limited to an investigation of the impact of investment in Occupational Health and safety (OHS) measures in steel manufacturing company in Uganda in a seven (7) years period. The study focuses on establishment of the existing OHS measures that define the occupational health and safety management system in place and the costs for the implementation of this system. The study identifies the work-related incident cases and the associated costs for a period of 7 years which are then compared with the costs of prevention and early interventions with the potential benefits. Case study is Roofings Rolling Mills Ltd located in Kampala Industrial Park, Namanve with a focus on three production plants of the same organization; Plant1, Plant2 and Plant3 which are run independently but are located within the same location.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

The literature on occupational health and safety (OHS) is presented in this section with a global perspective in order to develop a road understanding of common hazards and risks faced by employees in the industrial sector. Health and safety practices, OHS laws, and OHS policies and services. The literature review also offers a focused overview of OHS concerns in the steel manufacturing industry.

2.1 Classification of Occupational Health and Safety Hazards

The occupational health and safety (OHS) hazards that can lead to occupational accidents, illnesses, disabilities or even death through work in industries such as the steel manufacturing industries can be categorized as:

(i) Physical Hazards
(ii) Chemical Hazards
(iii) Respiratory Hazards
(iv) Mechanical Hazards
(v) Ergonomic Hazards
(vi) Biological Hazards
(vii) Psychosocial Hazards

2.1.1 Physical Hazards

The physical hazards in the industrial workplace are physical threats that can adversely impact employees' health such as high temperatures, vibration, noise, non-ionizing and ionizing radiation, extreme temperatures, and other unhealthy microclimate conditions. A number of these hazards are exposed to between 10 and 30% employees in developed countries and with around 80% in developing countries as per (Takele & Mengesha, 2006). A study that investigated small and medium scale (SMEs) casting and forging units in India reported that ambient noise was 22.23% greater than Occupational Health and Safety Administration (OSHA) permissible limits. And a survey reported that 68% employees do not use any PPE (Singh et al., 2010). Physical hazards have potential instant or cumulative effects on the wellbeing of workers; therefore, it is important for inspectors and employers to always be alert about protecting workers from adverse physical hazards that typically lead to heat stress, heat stroke, DNA injury, permanent or temporary hearing loss etc.

2.1.2 Mechanical Hazards

Unshielded equipment, hazardous systems and harmful exposed instruments are among the most prevalent mechanical hazards that affect the health of most employees at the workplace. Through applying basic cautions at the work place, operating procedures, safety structures, and ensuring acceptable managerial and behavioral practices most incidents can be avoided. Within a relatively short time, this will reduce accident rates dramatically. Accident reduction strategies have proven to be extremely cost-effective and achieve fast results. Nevertheless, lack of knowledge about such precautions, especially in sectors where performance and production have risen rapidly, has led to growing rates of workplace injuries.

2.1.3 Chemical Hazards

Different types of industrial chemicals are manufactured in large quantities worldwide are considered hazardous and some are even carcinogenic (Takele & Mengesha, 2006). The chemical effect, concentration, exposure time, and resistance ability of the exposed employees depend on the specific chemical hazards. The impact of chemical agents includes: Asphyxiation, Teratogenicity, Systemic intoxication, Carcinogens, Irritation, Mutagenicity, and Pneumoconiosis. The most infamous and in touch with the respiratory system or skin that require consideration is a solvent of all chemical reagents at work

2.1.4 Respiratory Hazards

A cross-sectional analysis on the steel pipe manufacturing factory employees in India identified infection of the upper respiratory tract (44%) demonstrated by dry cough, cough with fever and rhinitis. Employees with allergic bronchitis were represented by 12% while 13% represented those with heat stress as prickly heat, transpiration, and dehydration (Pandit & Tiwari, 2008). Additionally, a study that examined two production lines of steel in Iran reported that the respirable particulate matter average concentration was estimated at 22.14% more than the normal concentration (Rafiei et al., 2008).

2.1.5 Biological Hazards

Many biological agents have been found to exist and exposure of workers to biological agents (pathogens) such as parasites, viruses, bacteria, organic dusts, fungi, moulds, and any other living organism can cause diseases to human beings. Employees are susceptible to biological agents and face the risk of bacterial or viral infections, respiratory diseases and allergies. Blood borne pathogens, hepatitis B and C viruses, asthmas, tuberculosis infections (evident among health care employees), and chronic parasitic infections are the most common workplace diseases that result from such exposures. In the workplace, biological hazards exposure at a workplace results into a number of occupationally related diseases. Biological hazards may be passed on to a person by inhalation, injection, ingestion and contact with the skin (Takele & Mengesha , 2006)

2.1.6 Ergonomic Hazards

Ergonomics which is known as engineering of human factors is defined as the science of designing devices, services, and goods with consideration of the comfort, safety, and productivity of the employees using them. To adjust the design of goods and workplaces to the sizes of employees together with their strengths and weaknesses, ergonomists apply the basic concepts of industrial engineering, anthropometry (the science of human measurement), psychology, and biomechanics (the study of muscular activity). Ergonomists often consider people's reaction and how information is processed, and their ability to cope with psychological factors like stress or isolation. Ergonomists create the best possible concept for items and systems, from the toothbrush handle to the flight deck of the space shuttle, armed with this full image of people communicating with their surroundings.

2.1.7 Psychological Hazards

Psychological hazards refer to the way employees perceive their work tasks; up to 50% of all employees in industrial countries consider their task to be "mentally heavy". Psychological stress induced by time limits, the possibility of unemployment, and hectic work is widespread. Factors that have detrimental psychological consequences include occupations that are highly responsible for human or economic concerns, monotonous work tasks or work requiring continuous focus. Others factors that cause psychological stress include shift work, violence-threatened employment like police or jail work, and isolated work. The risks that are linked to psychological stress and overload include sleep disturbances, nervousness, fatigue, burn-out syndromes, and depression, hypertension, cardiovascular diseases, particularly coronary heart disease. Workers may also experience emotional stress caused by psychosocial factors in the workplace that the employee considers unsatisfactory, upsetting, or demoralizing. Besides helping employees deal with their difficulties, some strategies for reducing workplace stresses includes enhancing vocational guidance, arranging working hours, developing jobs, and working methods and good management.

2.1 Occupational safety, health hazards and risks in a steel manufacturing industry

Employees in steel manufacturing industries are exposed to a wide variety of hazards - such as air pollution, heat exposure, exposure to electrical burns and shocks, exposure to chemicals, and to noise and vibrations - which can trigger occupational illnesses linked to the eyes, lungs, skin and sometimes cause death (Bilga & Chohan, 2011). Additionally, machinery and equipment can cause injuries that result in physical body impairment.

2.2.1 Air Pollution

The air pollutants in a steel industry include soot, metal fumes, and oxides among others which have been a great concern to the respiratory system for a long time (Bose, 2007; Mentzakis & Delfino, 2010). Some of the impacts of air pollutants are readily detected while others take years or decades to manifest themselves (Bilga & Chohan, 2011; Barreto, 1997). An evaluation of respiratory health disorders among exposed employees and workplace environment was carried in iron and steel factory in Egypt reported that rate of chest pain cough chest tightness and dyspnea was much higher among the exposed community than in the control group (Abdel et al., 2009). There is risk of exposure to asbestos, mineral wools and fibres, and inhalable agents such as gases, vapors, dusts and fumes. Attendants on the furnace and preheating furnace areas may be exposed to dangerous gases like Sulphur dioxide and carbon monoxide (ILO, 2005). Air pollution causes adverse effects, which have been recognized for decades on human health.

2.2.2 Heat Exposure

There is risk of exposure to controlled and uncontrolled energy sources in a steel manufacturing plant. There is a risk of contact with hot metal, fire and explosion, extreme temperatures, radiation (non-ionizing, ionizing). Continuous exposure to hot air, heat and elevated temperature at the workplace induces psychological and body metabolic changes to the employees in steel manufacturing industries (Nigel, 2006). Among the occupational diseases arising from long term exposure to furnaces and other heat treatment processes are skin diseases. Many employees have taken personal protective equipment (PPEs) as luxuries yet for their good health, they are great necessities (Cherry et al., 2000). Dust particles and flying mill scales especially in hot rolling cause burns and eye injuries to the employees (ILO, 2005).

Figure 2. 1: Eight workers injured in a furnace explosion

(Source: Observer.ug report, 2020)

Figure 2. 2*:* Explosion on induction furnace *(***Source**: RRM incident report, 2014)

2.2.3 Machinery and Equipment Related Injuries and Accidents

The causes of machinery and equipment related accidents and injuries in the iron and steel industry include: slips, trips on the same level, falls from heights, exposure to unguarded machinery, falling objects, engulfment, moving machinery such as on-site transport, forklifts and cranes, working in confined spaces, failures due to automation, ergonomics, and manual handling and repetitive work. There are a number of trapping points at numerous machines in the finishing departments and clod cold rolling plants in steel manufacturing industry; there is a risk of an employee being trapped between the rolls. Trimming, shearing and cropping cause severe injuries to workers if those dangerous parts are not properly guarded. Workers normally get injuries when crossing roller conveyors at unauthorized points especially in hot rolling plants and accidents occur when changing rollers in stands. Employees are prone to being cut by strips or sheets when in contact with their edges and application of huge quantities of oils, corrosion inhibitors on strips/sheets pose a high risk to workers.

2.2.4 Exposure to Electrical Burns and Shocks

The steel manufacturing industry exposes workers to the risk of electrical burns and electric shock. Electricity is commonly used source of power energy in steel manufacturing industry. However, it is hazardous to workers with possible fatal results. Electric shocks account for fatalities some leading to death. These hazards include, electric burns, electric shocks, electric arcing, electrical fires and explosions which result from misuse of equipment, using defective equipment and unsuitable equipment. (ILO, 1992).

2.2.5 Exposure to Chemicals

The steel manufacturing industry exposes industry workers to the risk of chemical attacks through Skin contact with chemicals (irritants, acids, alkalis), and solvents. Steel industrial activities generate fumes, dust, vapours, mist, gases and liquids that cause ill-heath to workers if in contact by absorption through skin, ingestion and inhalation. Some of the activities in steel manufacturing industry require the use of chemicals that are hazardous to workers. These hazardous chemicals can be toxic, corrosive, flammable and reactive. Some chemicals are greatly dangerous, causing harm at low doses, on the other hand some allow extreme exposure without causing any harm to the worker. The effects on health can show quickly or over a long period of time (ILO, 1992).

2.2.6 Exposure to Noise and Vibrations

The workers in a steel plant are exposed to noise and vibration that comes from the production equipment. Another cause of occupational ill health in steel manufacturing industry is noise-induced hearing loss that occurs in areas where noise exceeds 85dB (A) (Bankole & Ibrahim, 2012)

2.3 Costs of Workplace Injury and Accident

Costs of injuries and accidents sustained in the steel manufacturing industry are more costly than they are traditionally considered because they comprise of both direct and indirect costs (Gagne, 2011). The direct costs of an accident are the most noticeable expenses that deal with visits to the emergency room and doctor, medical costs, medications, and recovery and the indirect costs are the costs related to an accident in order to bring the worker back to pre-injury status. Risk management and organizations are now concerned about the prevention of health/safety and accidents and their mutual understanding of the value of indirect costs incurred through accidents and diseases. There are also some unknown costs of injuries and accidents. Generally, the cost savings from safety are real which indicates that safety is important for prevention of injuries and accidents and also has a lot of economic relevance.

2.3.1 Direct Costs of Injuries and Accidents

Direct costs of injuries and accidents sustained in the workplace, such as medical costs for the injury or accident, are sometimes referred to as insured costs because they are costs that are covered by workers compensation insurance. The company pays insurance to cover the medical costs and the average insured costs depend on the severity of the injury or illness and the more accidents, the higher the insurance. Most industries control the expenses of injuries by monitoring items like employee’s compensation expenses and general medical costs for surgery or recovery which constitute direct costs. Direct costs include the worker’s benefit insurance, case management, emergency surgery charges, ancillary aids, medication and recovery, workers’ compensation, medical expenses, civil liability or litigation costs, and property losses (Thiede , 2015)

2.3.2 Indirect Costs of Injuries and Accidents

Indirect costs, referred to as uninsured costs, are additional costs associated with an injury or accident and are always 2 to 10 times more expensive than direct costs which are insured costs. Direct costs are a small part of the larger picture (Gagne, 2011). Indirect costs include workplace disruptions, loss of productivity, worker replacement, training, increased insurance premiums and attorney fees. The elements that constitute indirect costs include the following (Thiede, 2015).

(i) Reduced or lost productivity

(ii) Productive time lost by an injured employee,

(iii) Productive time lost by employees and supervisors helping the accident victim.

(iv) Hiring and training new employees,

(v) Time to go to medical appointments,

(vi) Administrative costs,

(vii) Loss of goods or services,

(viii) Damages to equipment, machinery, materials and facilities,

(ix) Management costs related to the injury including checks, inquires, meetings and administration,

(x) Slowed speed due to the fear of employees for injuries;

(xi) Cleanup and startup of operations interrupted by an accident;

(xii) Time to hire or train a worker to replace the injured worker until they return to work;

(xiii) Property damage: Time and cost for repair or replacement of damaged equipment materials or other property;

(xiv) Cost of continuing all or part of the employee's wages, plus compensation;

(xv) Reduced morale among your employees, and perhaps lower efficiency;

(xvi) Cost of completing paperwork generated by the accident; and

(xvii) OSHA penalties.

2.3.3 The Unknown Costs of Injuries and Accidents

The unknown costs of workplace accidents are costs which are difficult to measure yet they have a fatal effect on the success of the organization, for instance morale and reputation. There is always increase in employee turnover after the occurrence of an accident especially if it is fatality. The reputation of any organization is a direct reflection of its public image and must be considered as a vital factor that influences its success. A company that does not keep its workplace safe and healthful makes its employees and other members of the society think negatively about it; moreover, a company with a poor accident record cannot maintain a competitive advantage when hiring the best qualified people.

The most common injuries that keep workers away from work include strains or tears, soreness or pain, cuts, lacerations or punctures. The top three work injury categories that result into lost workdays include: overexertion, contact with objects and equipment, and slips, trips and falls. The top five occupations with the largest number of workplace injuries that result into lost workdays include: service (fire fighters and police), transportation/shipping, manufacturing/ production, installation, maintenance and repair, and construction (National Safety Council [NSC], 2019).

2.4 OHS Management System

Occupational Health and Safety is a science of expectation, identification, assessment and management of hazards that may affect the employees' health and well-being in the workplace by considering the potential effects on of the communities and the general environment (Alli & Benjamin, 2008). The availability of medical facilities, social security and continued OHS understanding have had a significant impact on employee efficiency, thereby improving productivity in the iron and steel manufacturing industries which is the relationship between financial inputs and outputs.

2.4.1 Aim of an OHS Management System

A formalized OHS management system is a collection of rules and related components of the general organizational management system that ensures that the industry's goals are accomplished to enhance the protection of both workers and the environment. The aim of an OHS management system is to give a structure for OHS risks and management opportunities.

The goal and expected results of the OHS management system are to avoid work-related accidents and diseases to employees for safe and healthy workplaces, by taking appropriate preventive and protective steps (ISO, 2018).The following key elements should be included in the OHS management system;

(i) OHS policy.

(ii) Required conditions to execute the organization, which is establishment of accountability and obligation, expertise and training, documentation, contact and information.

(iii) Assessment of hazards and risks, preparation and execution of OHS activities.

(iv) OHS performance evaluation and improvement action.

Some of the hindrances to OHS management include lack of OHS training, poor work organization, inadequate accident prevention and inspection, inadequate emergency first-aid and rescue facilities and workplace violence like harassment (Mankiw et al., 2007).

2.4.2 Design and Implementation of OHS Standards

The Occupational Health and Safety (OHS) management system is a collection of elements that are interrelated to create OHS policy and goals (ILO, 2005). OHS management system is designed to allow an organization create healthy and safer workplaces, avoid work-related accidents and ill health, and continuously improve its OHS efficiency (ISO, 2018). Implementation of an OHS management system in an organization requires approval of a manager who assigns financial resources to activities that constitute a system involved in demonstrating a positive attitude, total dedication and interest (Lulewicz, 2010).

The interventions to deliver the best policy results, influence organizational behavior and achieve genuine changes in the OHS performance are enforced in the design of the OHS standards at an affordable cost. The quality of the criteria and their coverage, the form of OHS standards and the strategy process through which standards are established and implemented are critical factors in developing OHS standards that meet these requirements. These concerns have a major impact not only on authorities, duty holders and future victims of work-related accidents and illnesses, but also for the overall efficiency of the regulatory regime. The different types of standards that could be invoked to protect OHS, with reference to four key options; specification, general tasks, performance-based and systematic process/systems-based standards. It aims to establish a better conceptualization of types of norms, their differences and their respective strengths and limitations in this way. Instead of OHS performance, a specification standard informs duty holders precisely what steps to take, that is, the exact preventive action needed in a particular situation.

2.4.3 Benefits of OHS Management

It is a moral feeling that in any workplace nobody is injured, suffers any form of illness, or get chronically depressed or ill health. The workplace should be structured in such a way that a sound physical and psychosocial environment is achieved. Another less commonly perceived positive aspect of being dedicated to OHS is employer branding, which makes employers more appealing to potential workers because of a reputation for prioritizing protection, well-being and fitness (Kok & Mojapelo, 2017).

2.5 Costs for Implementation of OHS Management System

Employers face high costs as a consequence of occupational injuries and diseases; these costs are from loss of trained personals, absenteeism, and high insurance rates; which justifies the need for implementation of measures for prevention, practice of monitoring, and inspection to prevent all the injuries and diseases (ILO,2015). The highest return on investment should be human capital; employers' decisions on OHS implementation should be based on whether it will keep employees safe but not on the prospects to deliver cost savings. The implementation of the OHS management system to be accomplished requires understanding the following elements that must be applied (Lulewicz, 2010).

(1) Occupational risk management (which is basically hazard identification and occupational risk assessment).
(2) Clearly specified training procedures in OHS, harmonization of training programs to meet the needs of special categories of employees.
(3) Supervision of the activities that result into harmful health and life hazards.
(4) Prevention system, preparation and response to occupational injuries and serious emergencies at work.
(5) System and management of OHS documentation.

All these elements can be done at a cost to enhance the health of employees in the steel manufacturing industries, but the industries have to allocate some funds and a team (information management team) to assist in training employees and enforcing the OHS management system. The allocated funds should be used by the information management team to:

(1) Informing employees of their role in enhancing the OHS management system and allowing them participate in the decision-making process.
(2) Implementing an incentive scheme that allows workers to participate in individual development practices.
(3) Making workers aware of the link between organizational goals described in the OHS policy and individual goals and benefits.
(4) Implementing a scheme of educating workers about the results and economic benefits created by the OHS management system.
(5) Developing procedures of continuous worker formation.
(6) Verification of the application of the acquired knowledge in enhancing the OHS management system.
(7) Stimulating processes of creativity that will solve problems found in formalized Systems.
(8) Shaping the organization's deep positive ties with its surrounding community in upgrading management and technical processes and improving production, which is the source of fundamental information.
(9) Diverging from codification of knowledge to the gain of knowledge personalization. If all these are put in place, then occupational accidents can be minimized at workplace.

2.6 The OHS Situation in Uganda

Occupational health and safety situation in Ugandan industries is characterized by inappropriate personal protective equipment (PPE) and clothing as shown in Figures 2.1 and 2.2. The Occupational Health and Safety Act (2006) provides measures for prevention and control of occupational injuries and accidents in Ugandan workplaces. The OHS act requires employers to protect their workers by implementing measures to ensure that workers and public are free from danger at workplaces. A majority of Ugandan companies were found to be non-complaint to a number of occupational health and safety requirements as presented in Table 2.1

Table 2. 1: Level of compliance with OHS requirements at sampled worked places by DOHS

OHS Requirement	Compliant	Non-compliant	% non-compliance
Written Workplace OHS Policy	10	40	80%
OSH officers to manage workplace OHS activities.	12	38	76%
Clear fire exits	9	41	82%
Fire alarms in place	14	36	72%
Fire drills conducted for staff	8	42	84%
Possession of first aid box/ facility	10	40	80%
Training of first aiders/ establishment of clinic	8	42	84%
Standard content list to detail the contents of the first aid box	5	45	90%
Expired (un-serviced) fire extinguishers	44	6	12%
No fire extinguishers	35	15	30%

Source: (DOHS, 2016)

Figure 2. 3: Employee working at a hot melting point without fire protective wear and safety shoes

Source: (DOHS, 2016)

Figure 2. 4: Employee welding without eye protection, safety Shoes and overall

Source: (DOHS, 2016)

Figure 2. 5: Few seconds before the explosion on induction furnace in 2014

Source: Author’s Findings, 2020

2.7 Impact of OHS on Performance of Industrial Organizations

Performance of organizations can be defined by productivity measurement which can be limited to labour productivity since it is hard to obtain numerical values for other productivity determinants (Mostafa, 2003). The impacts of OHS on labour productivity is observed in the aspects of the health of workers, safety in the organization, and level of risk.

2.7.1 Health of Workers

Health has a positive correlation with the productivity; improvement in health of workers leads longer life span among workers and this culminates into increase in cumulative output as indicated by the empirical findings (Weil et-al., 1992). The agony induced on workers and their families due to injuries and workplace related diseases is incalculable. The International Labor organization estimates that 4% of the global GDP is lost economically due to industrial injuries and illnesses. The fatality rate per 100,000 workers in sub-Saharan Africa is about 21 and the accident rate is 16,000 which means that 54,000 employees die annually and 42 million job-related injuries occur that result into at least three days absence from work (Alli & Bemjamin, 2008). On the other hand, by paying social compensation, medical expenses, retraining and replacement of employees and loss of production, low standards of OHS, industrial accidents, death and occupational diseases place a significant burden on the organization (Bardhylka, 2016).

2.7.2 Safety in the Organization

Safety has a positive correlation with the productivity due to the conducive environment that is created by high levels of safety. The workers' performance is increased by reduced incidences of injury and fatality (Akinye, 2007; Lambert, 2005). Occupational Health and Safety is an important aspect of employees' social security against adverse aspects of employment, workplace injuries and occupational diseases. This increases employee satisfaction and enhances the functioning of the labor market and the quality of human resources.

2.7.3 Level of Risk

The level of risk has an inverse correlation with productivity. The working environment tends to be less conducive as the level of risk increases which affects the morale of the workers as indicated by the findings of Leigh (1995).

2.8 Identification of Occupational Health and Safety Hazards

According to the International Labour Organization (2005), a hazard is the intrinsic ability of a material or physical condition to cause damage or harm to peoples' health. Employees face a number of hazards which affect their efficiency such as safety, physical, chemical, mechanical, biological, economic and psychological hazards (Mankiw et al., 2007). OHS risks are also identified through observations of adverse effects among employees; it is important to consider possible problematic areas and identify their scope. Recognition of significant hazards, predicted accidents and diseases, illnesses and incidents determine the choice and execution of specific measures to prevent workplace injury and ill health. Observations of adverse health effect among employees have also contributed to the detection of OHS threats; it is important to consider potential problem areas and identify their scope. Occupational and safety hazards have to be defined to increase productivity in steel manufacturing industries. The purpose for the identification of OHS hazards is to be able to:

(i) Obtain information about occupational health stresses
(ii) Obtain data on working conditions
(iii) Collect data on procedures and goods
(iv) Obtain threshold limits for substances
(v) Collect data on the influence of human exposure
(vi) Collect exposure levels knowledge by performing elementary measurements
(vii) Determine the potential problem areas

2.9 Framework for Occupational Health and Safety Evaluation

Identification of the OHS hazards is very important in laying the framework for assessment of occupational health and safety which gives a lot of knowledge used in the evaluation phase. The recommended workplace safety and health policies are a vital aspect of protecting workers against negative workplace trends, reducing workplace injuries and occupational diseases, enhancing employee satisfaction and improving the quality of life for employees. Incidents of occupational stress exposure where occupational exposure limits are not reached are removed from the comprehensive evaluation which reduces the overall process of evaluation and monitoring. Identification often saves time, effort and costs for the industry. In every sector, the identification of health and safety hazards in any industry is a step-by-step procedure that includes the following (Takele & Mengesha, 2006):

(i) Observe workplace

(ii) Evaluate complaints from employees

(iii) Examine injuries and near-miss reports

(iv) Examine the figures reported on sicknesses

(v) Use easy surveys to inquire from co-workers on their health and safety issues

(vi) Use check-lists for your workplace inspection.

(vii) Know the outcomes of the employer, the union or someone else's inspection.

(viii) Read the report documentations about the workplace

CHAPTER THREE
METHODOLOGY

3.0 Introduction

The research methods and investigation procedures to be followed in executing the study are presented in this chapter. The content of this chapter includes a description of the research design, target population and sample size determination, sampling procedure, research equipment and their validity and reliability, tools for data collection, the methods for data analysis and ethical considerations.

3.1 Research Design

A descriptive survey study was adopted as the research design in an attempt to answer all the research questions in the study that was executed. The study reviewed incident cases registers, training records, records on hazard identification and risk assessments conducted, documentation on health and safety programs and the OHS policy, records for employee compensation claims, records for work time lost.

3.2 Target population

The target population was the staff members of which comprises of three plants; plant1, plant2, and plant3 and the staff employees for three plants were part of the study.

3.3 Sample size and sampling procedure

Representative subjects formed the sample size for the study; this is calculated using Cochran's sample size formula while considering population size at 95% confidence level and 5% margin error. Simple random sampling was applied to select subjects from each plant. The researcher also used purposive sampling to select management members who make decisions on OHS in the organization for some interview questions.

3.3.1 Determination of sample size

Sample size was determined using Cochran's sample size formula (Cochran, W. G, 1977)

Cochran's sample size formula, $N_0 = \left(\frac{Z^2PQ}{e^2}\right)$……………………………. (3.1)

Where;

e = desired level of precision (margin of error); the acceptable margin of error for proportion being estimated, P= estimated proportion of the population, Q= 1-P, Z-value is found in z-table using 95% confidence level, Precision is of +/-5, 95% confidence level gives z-value of 1.96 (from normal tables)

Therefore $N_0 = ((1.96)^2 \text{ x } (0.5)\ (0.5))/\ (0.05)^2$

$N_0 = 385$

Since we were studying small population; the sample size calculated in the above formula was modified. Cochran's correction formula, when population is less than 50000;

$$N_1 = \left(\frac{N_0}{1 + \frac{(N_0 - 1)}{N}} \right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.2)}$$

Where;

N_0 = Cochran's recommended sample size, N= Population size, N_1 = New adjusted sample size.

3.3.2 Sample size in each production plant;

$$\boldsymbol{N_1^P} = \left(\frac{\text{Emplyees number in each dept}}{\text{population number}}\ \boldsymbol{x} \text{ sample size} \right) \ldots\ldots\ldots\ldots\ldots \text{(3.3)}$$

Using equation 3.2 for determining the adjusted sample size;

$$N_1 = \left(\frac{385}{1 + \frac{(385-1}{641}} \right)$$

Adjusted sample size = 242

The sample of 242 employees as calculated using (Cochran, 1977) is supported by Krejecie and Morgan sample size table (Krejecie & Morgan, 1977)

Using equation 3.3 for determining Sample size for plant1;

$$N_1^1 = \left(\frac{73}{641}\right) X\ 242$$

Sample size for plant 1 =28

Sample size for plant 2

$$= N_1^2 = \left(\frac{181}{641}\right) X\ 242$$

Sample size for plant 2 = 68 samples

Sample size for plant 3

$=N_1^3 = \left(\frac{387}{641}\right) X\ 242$

Sample size for plant 3=146

Table 3. 1: Population target and study sample size

Plant	No of staff	Sample size
Plant 1	73	28
Plant 2	181	68
Plant 3	387	146
Total	**641**	**242**

3.4 Data collection methods

Data on injuries, treatment costs, introduction of OHS, and certifications were collected from past records complemented by information from personal interviews to enable calculations of as many monetized costs and benefits as possible. The study used structured questionnaires, personal interviews and reviewed all past records; incident cases registers, and general ledgers for compensation claims. Different OHS preventive measures were identified through personal interviews with key personnel and management representative while supported by observations of the researcher. The pilot study was applied in order to identify flaws and improve the feasibility of the administration of the process. The questionnaires were pre-tested for length, clarity and suitability. The consent forms were presented to the employees before the interviews and explained to them the nature of the study and its topic, the purpose of the study, the type of information and their level of commitment to the study.

3.4.1 Identification of OHS measures that are in place

Purposive sampling was adopted in this study after the pilot-study. The key personnel considered in the study included Safety officers, clinic officers, workers' representatives and management representative. Different risk control measures that have been put in place were identified through personal interviews with key personnel who had stayed since 2013. This was supported by walk through observations across the production plants. OHS procedures and programs that have been put in place and the existing OHS policy were examined; this helped the researcher to describe the level of implementation of OHS management system.

3.4.2 Determination of costs associated with OHS measures and work-related incidents

The study reviewed records and reports such as incident cases register, investigation reports about work related injuries and diseases and data on injuries, accident investigation costs, treatment costs, training and information costs, and costs associated with procurement and provision of PPE, employee compensation claims, introduction of OHS and certifications were obtained through reviewing records, reports and registers from the concerned personnel. This was complemented by information from personal interviews. The respondents constituted the safety and health personnel, insurance officer, clinic in charges, and management personnel.

3.4.3 Impact of the implementation of OHS systems.

All the intangible benefits were given by the key personnel (safety officers, Human resource officers, workers' representatives, clinic officers, management representative) through interviews. Records (incident cases register) on the worker injury rates were examined and cost savings in monetary terms calculated. Cost benefit analysis was done.

3.4.3.1 The impact of health and safety on employee's productivity

Health and safety have a correlation with labour productivity and both gender and the level of risk have the potential of affecting the workers' performance; males are more in risky jobs than females.

a) **Empirical model specifications**

Gender and the levels of risk will be used to reduce the estimation bias connected with predictors. The empirical model of the study is given as;

Y = f (health, safety)

$$Y = \beta_0 + \beta_1 \text{GENDER} + \beta_2 \text{LOW RISK} + \beta_3 \text{MEDIUM RISK} + \beta_4 \text{HIGH RISK} + \beta_5 \text{HEALTH} + \beta_6 \text{SAFETY} \quad \ldots\ldots\ldots\ldots (3.4)$$

GENDER is a dummy variable for male or female and low, medium and high are proxies for risks which are also dummy in nature.

The risks in this study have been categorized as indicated below;

Table 3.1.1 Procedure of categorizing the levels of risk

RISK SCORE - SCALE					
Likelihood of Occurrence (LO)					
Very likely	4	8	12	16	
Likely	3	6	9	12	
Less likely	2	4	6	8	
Not likely	1	2	3	4	
	Minimum	Less	Serious	Very Serious	**Consequence Score (C)**

Source (ISO, 2018)

Table 3.1.2 Levels of risk as per risk factor

Risk Factor	**Risk Level**
8 to 16	High risk
4 to 6	Medium risk
1 to 3	Low risk

Source: (ISO, 2018)

Risk Factor = Likelihood of Occurrence (LO) * Consequence (C)

b) **Estimation techniques**

The multivariate multiple regression model was used in this study to determine the level to which health and safety affect labour productivity hence the performance of organization.

In matrix notation the general multivariate multiple models take this form;

$$\begin{pmatrix} y_{11} & y_{12} & \cdots & y_{1p} \\ \vdots & \vdots & \cdots & \vdots \\ y_{n1} & y_{n2} & \cdots & y_{np} \end{pmatrix} = \begin{pmatrix} 1 & x_{11} & \cdots & x_{1q} \\ \vdots & \vdots & \cdots & \vdots \\ 1 & x_{n1} & \cdots & x_{nq} \end{pmatrix} \begin{pmatrix} \beta_{01} & \beta_{02} & \cdots & \beta_{0p} \\ \vdots & \vdots & \cdots & \vdots \\ \beta_{q1} & \beta_{q2} & \cdots & \beta_{qp} \end{pmatrix} + \begin{pmatrix} \varepsilon_{11} & \varepsilon_{12} & \cdots & \varepsilon_{1p} \\ \vdots & \vdots & \cdots & \vdots \\ \varepsilon_{n1} & \varepsilon_{n2} & \cdots & \varepsilon_{np} \end{pmatrix}$$

y's represent the labour productivity measures while x's are the regressors as shown in equation (3.4). n represents the sample size

Labour productivity will be measured on attendance, quality of work performance, the production (quantity of work done), and the morale of the employee.

The multivariate model hence takes the form;

$$\begin{pmatrix} y_{11} & y_{12} & \cdots & y_{14} \\ \vdots & \vdots & \cdots & \vdots \\ y_{n1} & y_{n2} & \cdots & y_{n4} \end{pmatrix} = \begin{pmatrix} 1 & x_{11} & \cdots & x_{16} \\ \vdots & \vdots & \cdots & \vdots \\ 1 & x_{n1} & \cdots & x_{n6} \end{pmatrix} \begin{pmatrix} \beta_{01} & \beta_{02} & \cdots & \beta_{04} \\ \vdots & \vdots & \cdots & \vdots \\ \beta_{61} & \beta_{62} & \cdots & \beta_{64} \end{pmatrix} + \begin{pmatrix} \varepsilon_{11} & \varepsilon_{12} & \cdots & \varepsilon_{14} \\ \vdots & \vdots & \cdots & \vdots \\ \varepsilon_{n1} & \varepsilon_{n2} & \cdots & \varepsilon_{n4} \end{pmatrix}$$

Where;

$y_{.1}$ represents the worker's presence at workplace/ attendance

$y_{.2}$ represents quality of work performance

$y_{.3}$ represents quantity of work done

$y_{.4}$ represents employee morale and the regressors are represented by $x_{.j}$

The model for the worker's presence at work becomes

$$\begin{pmatrix} y_{11} \\ \vdots \\ y_{n1} \end{pmatrix} = \begin{pmatrix} 1 & x_{11} & \cdots & x_{16} \\ \vdots & \vdots & \cdots & \vdots \\ 1 & x_{n1} & \cdots & x_{n6} \end{pmatrix} \begin{pmatrix} \beta_{01} \\ \vdots \\ \beta_{61} \end{pmatrix} + \begin{pmatrix} \varepsilon_{11} \\ \vdots \\ \varepsilon_{n1} \end{pmatrix}$$

This is a univariate multiple regression model which shows the effect of health and safety on the employee's presence while at work. Similar models can be written for other labour productivity measures.

The coefficients of Health and safety in equation (3.4) will indicate the extent to which labour productivity measures are affected by these regressors

3.5 Validity and reliability of data collection instruments

Validity of data collection tools and reliability is vital in minimizing bias in research results and findings.

3.5.1Diagnostic tests

In regression analysis, a diagnostic test should be carried out to determine the statistical precision of the data set collected. Normality test, multicollinearity test and heteroscedasticity test were performed.

3.5.1.1 Normality test

Normality test is intended to determine the distribution of the data in the variable that was be used in study. Kolmogorov-Smirnov normality test using IBM SPSS 26 was adopted for this study.

- If the Sig. value > 0.05, then the data is normally distributed.
- If the Sig. value <0.05, then the research data is not normally distributed.

3.5.1.2 Multicollinearity Test

It is necessary to do multicollinearity test in order to determine the similarity between the independent variables. Multicollinearity can be detected using various techniques, one technique being the **Variance Inflation Factor (VIF).**

- If the VIF value lies between 1-10, then there is no multicollinearity.
- If the VIF <1 or> 10, then there is multicollinearity

3.5.1.3 Heteroskedasticity test

Heteroskedasticity test is useful to examine whether there is a difference in the residual variance of the observation period to another period of observation. Many statistical methods that can be used to determine whether a model is free from the problem of heteroscedasticity or not, such as White Test, Test Park, and Test Glejser.

- If the value Sig. > 0.05, then there is no problem of heteroscedasticity
- If the value Sig. <0.05, then there is a problem of heteroscedasticity

3.5.2 Validity of data collection instruments.

This is the degree to which the items in an instrument adequately represent concepts being measured. It gives the importance of the data collection instruments relative to the anticipated results of the study. The researcher formulated easy to understand questions whose answers were linked to the variables under investigation. In addition, the researcher did a pilot study prior the main study in order to identify any weaknesses in the data collection instruments; corrections were then made.

3.5.3 Reliability of the data collection instruments

Reliability refers to the ability of the instrument to give similar outcomes consistently when the same study is repeated under similar conditions. A pre- test was done by administering questionnaires to randomly selected two (2) employees in each plant to ascertain if the questions were understood and answered in relation to the study. The observed weaknesses of many questions (lengthy questionnaire) were noted and corrected.

3.6 Data analysis and presentation methods

The data on productivity measures was collected and analyzed both qualitatively and quantitatively using the IBM SPSS STATISTICS 26. This study used multivariate regression analysis method to evaluate the extent of the impact of regressors on labor productivity.

Analysis of regression is aimed at determining the influence level of each factor to the overall factor through coefficient β. The higher coefficient β shows the significant effect on the overall factors of that factor. Coefficient β has a valuation within -1 and +1 and can be defined as:

- If value β > 0: positive correlation relationship between independent variables and dependent variables.
- If value β < 0: negative correlation relationship.
- If value β is closer to 1: the more coherent the correlation relationship between independent variables and dependent variables is.
- If value β is closer to 0: the lower the correlation relationship between independent variables and dependent variables.

Coefficient of Determination; R^2 (Wheelan, 2014).

- R^2 = SSR/SST……………………………………….3.5
- R^2 = 1-(SSE/SST)…………………………………….3.6

$SSE = \sum_{i=1}^{n}(y_i - \hat{y}_i)^2$ ………………………………3.7

$SSR = \sum_{i=1}^{n}(\hat{y}_i - \bar{y})$ …………………………………...3.8

$SST = \sum_{i=1}^{n}(y_i - \bar{y})^2$………………………………….....3.9

- SSE = Σ(actual-predicted)²
- SST= Σ(actual-mean)²
- SSR= Σ(predicted-mean)²

SSE (Sum of Squared Error)

The Sum of Squared Error is the difference between the observed value and the predicted value. Sum of squares (SS) is a statistical tool that is used to identify the dispersion of data as well as how well the data can fit the model in regression analysis. The sum of squares got its name because it is calculated by finding the sum of the squared differences (Beyer, 2002)

$SSE = \sum_{i=1}^{n}(y_i - \hat{y}_i)^2$ ……………………………………………….3.7

Where:

$\hat{y}_i$ – The observed value

$\hat{y}_i$– The value estimated by the regression line

SSR (Sum of Squared Regression)

The Sum of Squared regression is the sum of the differences between the predicted value and the mean of the dependent variable. The regression sum of squares describes how well a regression model represents the modeled data. A higher regression sum of squares indicates that the model does not fit the data well (Vogt, 2005).

$SSR = \sum_{i=1}^{n}(\hat{y}_i - \bar{y})$……………………………………………………3.8

Where:

$\hat{y}_i$ – The value estimated by the regression line

ȳ – The mean value of a sample

SST (Sum of Squared Total)

Sum of Squared Total is the squared differences between the observed dependent variable and its average value (mean). One important note to be observed here is that we always compare our linear regression best fit line to the mean of the dependent variable slope (Wheelan, 2014).

$TSS = \sum_{i=1}^{n}(y_i - \bar{y})^2$……………………………………………………3.9

Where:

y_i – The value in a sample

ȳ – The mean value of a sample

Regression analysis was conducted with the support of the IBM SPSS.26 software.

3.7 Data management and control

A period of eight weeks was given for collection of data. Key personnel namely OHS officers, insurance officer, clinic officers, and the management representative were interviewed and all the required data as per the research objectives was collected. A total of 242 questionnaires were administered across the three plants. 208 questionnaires were used in the analysis, 34 questionnaires were dropped due to either discrepancy in the answers or non-responses. Thus, a response rate of 86 percent was recorded in this study. Males were dominant in the study with a response rate of 91 percent and that of the females was 9 percent. The share of males in the survey reveals the dominance of males in the formal sectors of employment in the Ugandan economy.

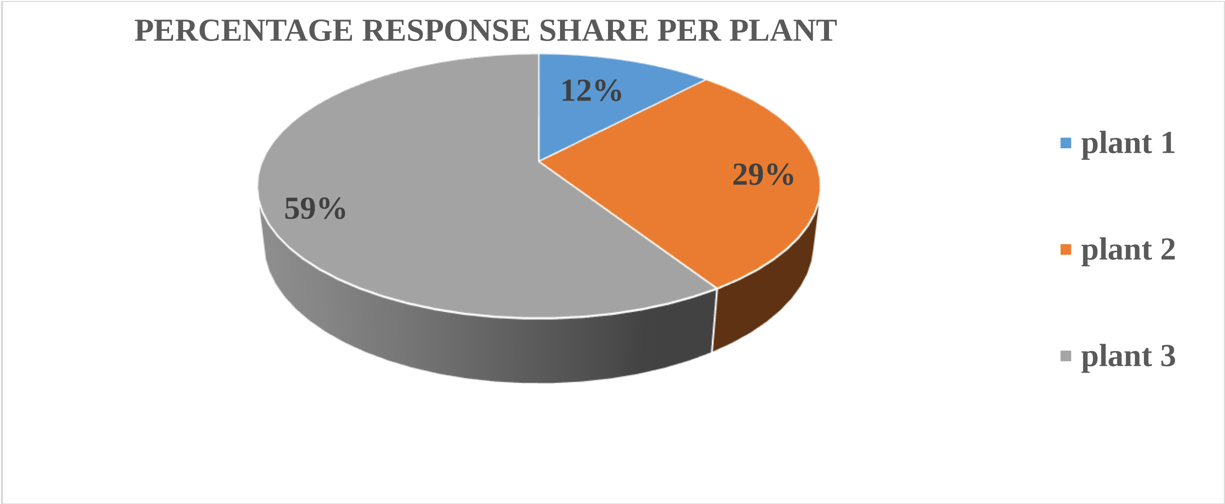


Figure 3. 1: Percentage share of response per plant

Figure 3.1 displays the percentage share of plants (Plant1, Plant 2 and Plant 3) that were considered in the study for fulfilling objective four. Plant 3 has the highest percentage share of 59 percent, Plant 2 followed with 29 percent and Plant 1 has the least response share of 12 percent. The differences in response shares are attributed to the fact that Plant 3 has the highest population size compared to other plants followed by Plant 2 and Plant 1 with the lowest number of employees.

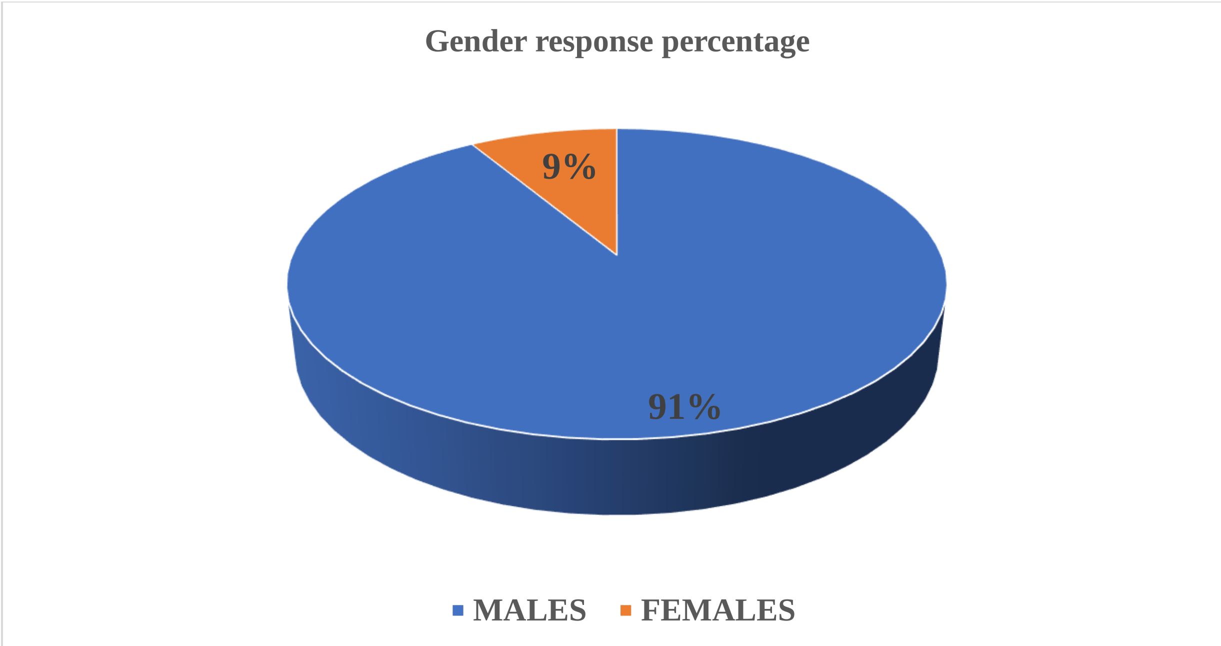


Figure 3. 2: Gender response percentage

Figure 3.2 shows the response percentages per gender from valid questionnaires; the males were the majority with 91 percent while females with 9 percentage. This indicates that males dominate in the sector of employment in the steel industry of the Ugandan economy.

3.8 Ethical considerations

This concerns the confidentiality of the information to be collected from the respondents. The respondents were guaranteed of confidentiality of the information they disclosed for sensitive questions. The respondents were made to understand that the study is basically academic with a purpose of fulfilling the requirements of the master's degree and hence an introduction letter from the university was necessary.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.0 Introduction

This chapter mainly covers the presentation, analysis and discussion of the findings and results. It analyses the OHS measures that have been implemented between 2013 and 2019. It also clearly analyses the relationship between OHS measures costs, the incident cases and the injury direct costs.

4.1 levels of risk for workers

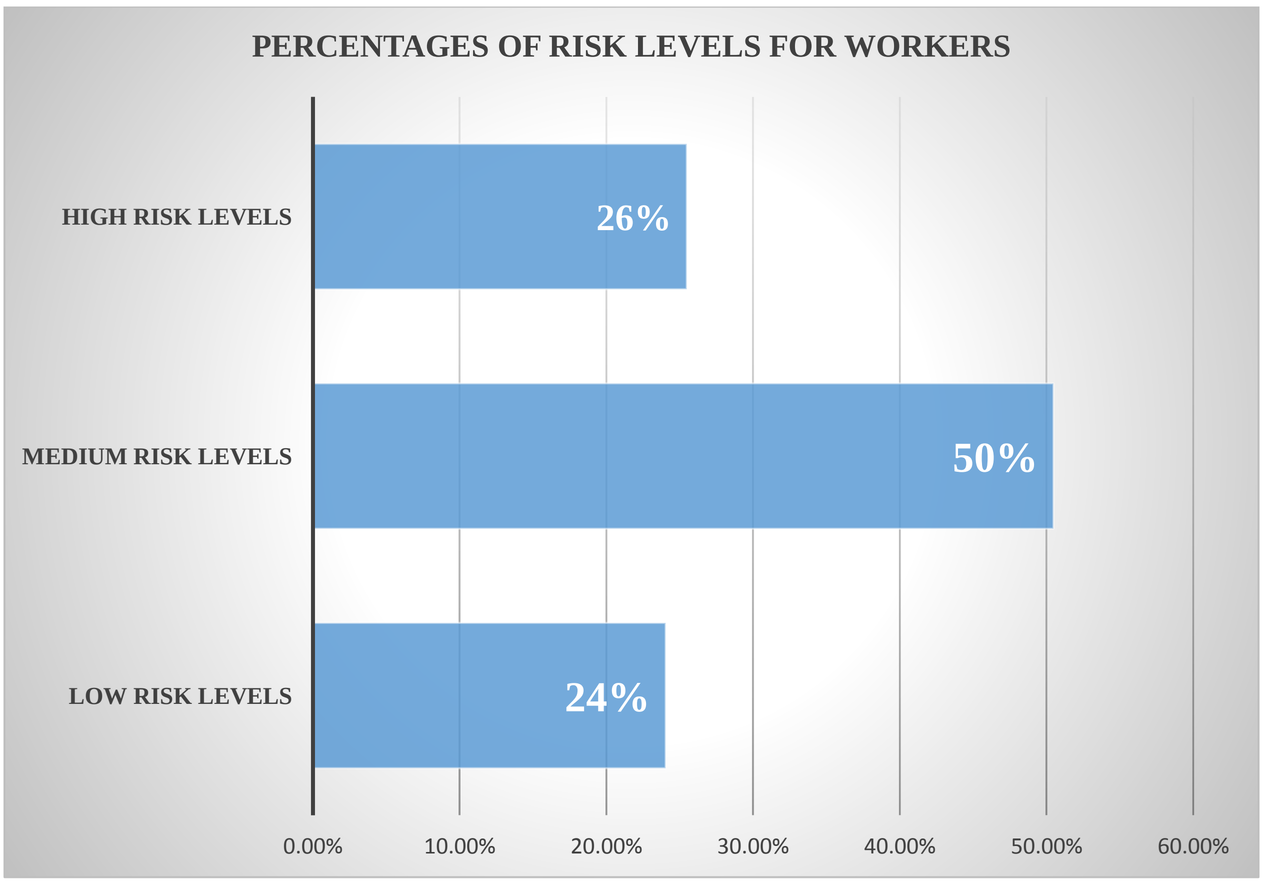


Figure 4. 1: Percentages of risk levels on respondents: (Author's survey, 2020)

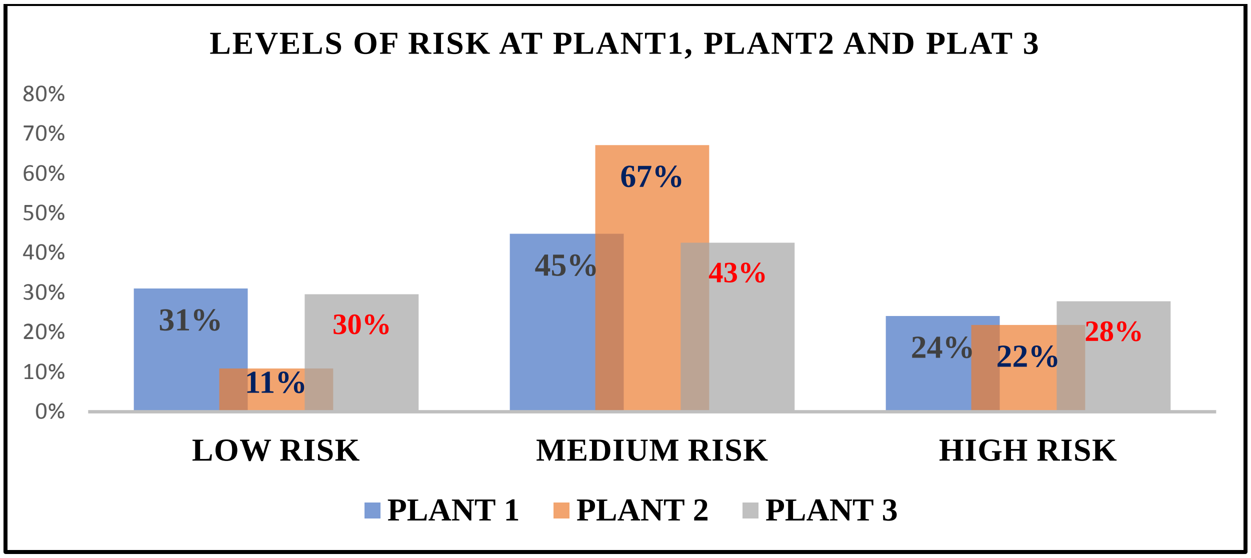


Figure 4.1.1: Levels of risk at plants (Author's survey, 2020)

Table 4.1.1: Risk register from HIRA studies (source: Author's survey, 2020)

RISK REGISTER FROM HIRA STUDIES		
Source of risk	**Risk category**	**Level of risk**
chemical fumes (conc. Sulphuric acid)	Difficulty in breathing, chest pain, headache, skin irritation	**M**
Metal dust	Respiratory damage	**M**
Hot metal	Burns	**M**
Used chemical solution	Environmental impact	**H**
Rebar rupture	Injuries	**M**
Hot metal, sharp metal, Noise and Non conformities	Heat stress, dehydration, burns, cuts, hearing loss, company loss, dissatisfaction to the customer	**H**
Oil leakage, oil spillage	Fire outbreak, environmental pollution, slippery surfaces	**M**
Lifting Heavy machinery	chest pain, muscle fatigue, fractures	**M**
Reduction in billet	high temp.(hot outs), fumes, hot billets, metallic dust, blocked walkways	**M**
Cutting of finished products	hot rebars, noise, sharp rebars, fumes	**M**
Sharp scrap, metallic dust, explosives, heavy scrap	injuries, death, muscle damage	**H**
Hot molten metal splash, heat, boiling of molten metal, molten metal over flow, smoke,	Injury, death(fatal), dehydration, damage of furnace accessories, respiratory damage	**H**
Loose chains, crane breakdown	Injuries, death(fatal)	**H**

Figure 4.1 displays the percentages of workers with risk levels; 50 percent of respondents confront medium risky jobs; 26 percent are exposed to high risky jobs and 24 percent of respondents confront low risky jobs. The study shows that the biggest number of workers in Roofings Rolling Mills Ltd are exposed to medium risky jobs, the number of workers exposed to high risky jobs take the second position and those exposed to low risky jobs take the least number.

These different levels of risk that workers are exposed to clearly justify the need for the control measures to either eliminate or reduce the risk levels. The different levels of risk at plant1, plant 2 and plant 3 helps the organization to allocate the budget with first priority given to plant 2. According to (Alli and Benjamin,2008) low risky jobs remotely cause injuries with no lost time, medium risky jobs can cause injury if no preventive action is taken and are associated with lost time. High risky jobs can cause fatal injury or illness immediately or in near future.

4.2 Identified OHS Measures

The identified OHS measures fall under the category of administrative controls, these include Warning systems and safety signage, firefighting mechanisms (fire extinguishers' service and refiling), OHS Trainings and awareness, ISO surveillance audit, certification and recertification, ISO systems consultation and awareness and OHS personnel. All the structural changes and modifications at various workstations are under engineering controls and these are machine guards, handrails, exhaust ventilation systems and all risk barriers. Other measures include the personal protective equipment namely respirator/dust masks, safety boots/shoes, helmets, aprons, safety uniforms, ear protectors, face shields, gloves and leg protectors.

Table 4.1 provides a list of the different OHS measures that have been put in place to protect the health and safety of the worker while executing his or her work for the three plants. 9 key personnel were interviewed to give the OHS measures that have been implemented from 2013 to 2019. The interviewed personnel included 3 safety officers, 1 management representative, 2 clinic officers, and 3 workers’ representatives from Plant 1, Plant 2 and Plant 3.

Table 4. 1: OHS measures

S/N	OHS Preventive Measures	**Number**	**Percent**
1	Clinic facilities and maintenance	06	67
2	Firefighting mechanisms (fire extinguishers' service and refiling)	07	78
3	Warning systems and safety signage	8	89
4	Provision of milk to highly exposed employees	06	67
5	ISO surveillance audit, certification and recertification	07	78
6	ISO systems consultation and awareness	05	56
7	OHS Trainings and awareness	07	78
8	Procurement and issuing of PPEs	09	100
9	OHS personnel and staff	07	78
10	Structural changes and modifications at the workplaces	04	44
		Out of 9	Out of 100

Source: (Author's survey, 2020)

Figure 4.6 displays the different OSH preventive measures Roofings Rolling Mills Ltd has invested in to protect the health and safety of the worker from 2013 to 2019.

From the graph, 100 percent listed the procurement and issuing of personal protective equipment, warning systems and safety signages were given by 89 percent, 78 percent listed OSH trainings and awareness, OSH personnel and ISO certification. 67 percent mentioned clinic facilities and maintenance and provision of milk to some employees depending on the hazard type (extreme heat, dusty areas and those exposed to chemicals). 56 percent mentioned ISO consultation and awareness. 44 percent gave structural changes and modifications as a preventive measure also.

Figure 4. 2: Some of Administrative control measures observed in place

Figure 4. 3: Some of Engineering control measures observed

Figure 4. 4: PPES usage

Figure 4. 5: Clinic facility

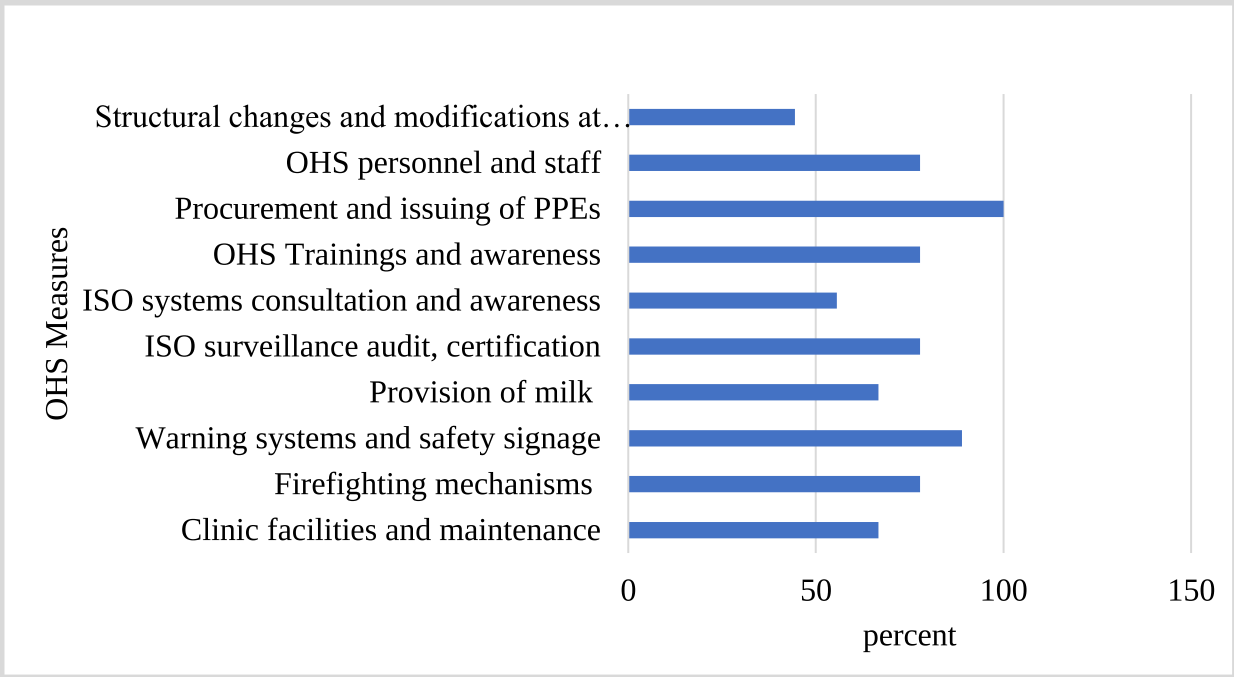


Figure 4. *6*: OHS measures

Source: (Author’s survey, 2020)

4.4 Costs for OHS measures

Table 4.2 contains the aggregated costs (ugx) incurred while implementing the different categories of preventive measures from 2013 to 2019. Majority of the costs for administrative controls, engineering measures and for personal protective equipment were considered. ISO certification for OHS management system (BS OHSAS 18001:2007) was attained in 2015 for Plant3 which is the main plant and hence 2013 and 2014 are considered to be the years before certification, for our analysis. All costs for annual surveillance audits, certification and recertification process, regulatory compliance activities were captured. Salaries for the OHS officers, clinic staff from 2013 to 2019 were considered also. All these costs are considered to be linked with accident prevention costs.

Table 4. 2: Costs for OHS measures **(in thousands UGX)**

S/N	OHS measures	2013	2014	2015	2016	2017	2018	2019
1	clinic facilities and maintenance	32,889	37,179	43,119	65,243	75,659	78,656	102,045
2	Fire extinguishers' service and refiling	11,900	4,187	4,073	6,656	5,520	5,835	4,401
3	Safety and warning signage						5,900	5,781
4	provision of milk to highly exposed employees	15,790	53,187	42,822		40,635	59,200	61,827
5	ISO surveillance audit, certification and recertification	7,644	6,052	11,727	6,398	9,781	14,893	13,204
6	ISO systems consultation and awareness		9,835	25,830			23,600	
7	OHS Trainings							11,525
8	Procurement and issuing of PPEs	99,301	83,931	85,350	59,957	64,748	143,854	151,537
9	OHS personnel and staff salary	9,600	9,600	24,000	36,000	36,000	43,200	46,800
10	Structural changes and modifications				77,569	19,804		
	TOTAL COSTS	**177,124**	**203,971**	**236,920**	**251,824**	**252,147**	**375,138**	**397,120**

Source: Author's survey, 2020

4.5 Workers direct injury costs

Table 4.3 contains the different injury categories and the lost time in days due to injuries from 2013 to 2019. The total time lost as a result of disabling injuries does not include the additional time lost for medical reviews when the injured worker resumes work. It was noticed that accidents that happened in previous years usually continue to induce lost time in the new year.

All injuries that had been registered at the clinic were split into three categories:

- Minor injuries, estimated to result in the loss of one hour a day's work.
- Major injuries but treated and managed at clinic, estimated to result in the loss of at least a one day of work.
- Referral cases requiring hospitalization, estimated to lead to a loss of at least one day of work.

Table 4. 3: Lost workdays and injury categories in numbers

YEAR	LOST TIME/DAYS	Injury Categories In Numbers			Total Injuries In Numbers
		Minor Injuries	Major Injuries	Referrals	
2013	1,431	279	15	27	321
2014	561	140	15	18	173
2015	361	111	24	8	143
2016	310	107	33	7	147
2017	431	70	21	16	107
2018	205	60	12	9	81
2019	615	29	23	11	63

Source: Author's survey, 2020

Table 4. 4: Total compensation claims between 2013 and 2019 (**in thousands ugx**)

Compensation claims	2013	2014	2015	2016	2017	2018	2019
Medical expenses	47,322	30,435	31,461	12,436	24,120	10,294	13,403
Permanent damage claims	79,176	58,675	49,885	17,600	9,631	21,456	24,114
Total compensation claims	**126,498**	**89,110**	**81,346**	**30,036**	**33,751**	**31,751**	**37,517**

Source: Author's survey, 2020

Table 4.4 contains the aggregated compensation claims for both the employee and employer against the injury risk for years from 2013 to 2019. The medical bills for the injured worker and the permanent incapacity benefits for the workers including machine damage were all summed up to get the total compensation claims.

Table 4. 5: Workers' Injury Direct Costs (UGX) between 2013 and 2019

YEAR	Minor Injury Cost	Major Injuries Costs At Clinic	Lost Time Injury Costs	Total Compensation Claims	Total Injury Direct Costs
2013	2,790,000.00	750,000.00	39,370,526	126,498,357	169,408,882.63
2014	1,400,000.00	750,000.00	15,422,158	89,109,546	106,681,703.33
2015	1,110,000.00	1,200,000.00	9,984,506	81,346,186	93,640,691.63
2016	1,070,000.00	1,650,000.00	8,539,968	30,035,549	41,295,517.13
2017	700,000.00	1,050,000.00	11,852,086	33,751,371	47,353,457.25
2018	600,000.00	600,000.00	5,571,788	31,750,718	38,522,505.50
2019	290,000.00	1,150,000.00	16,911,407	37,516,816	55,868,222.88

Source: Author's survey, 2020

Table 4.5 contains the worker direct injury costs for years from 2013 to 2019. They include the lost time costs, medical costs, property damage costs, and workers permanent incapacity benefits. All these costs were got from accounts general ledgers for different days of the period considered in study. The indirect costs associated with the injuries were not captured in this study. Most companies in developed countries widely use 20 percent to calculate the indirect costs in mining industry (Blumenstein et-al., 2011). According to Gagne (2011) the cost multiplier factor for indirect costs varies between 3 to 10 times the direct costs for work related injuries. This clearly shows that injuries/accidents are too costly. The indirect costs include Lost/decreased productivity, Time to go for medical reviews, Production down time, Administrative costs, Additional overtime pay required, Time for replacement of injured worker, Interviewing and training new employee, Unwarranted negative media attention, Potential OHS penalties, Reputation loss, Degraded client loyalty and support, Managerial costs due to the accident including inspections, investigations, meetings and administration, Loss of employee time associated with assisting with the accident, administering first aid, and witness interviews, Loss of employee morale, Slowed work pace due to other employees fear of injury (Gagne, 2011).

A study by the Stanford University, 1982, estimated that indirect costs could be four times higher than direct costs. Many findings also show that it is quite hard to calculate indirect costs than direct costs (Thiede, 2015).

4.6 Benefits of incremental investment in OHS measures

Table 4.6 displays the result that indicate the benefits and the respondents' number who listed the benefits**.** The study identified the benefits that employees and employer enjoy as a result of the occupational safety and health measures. These benefits were given by the 11 key personnel who included 3 safety officers, 2 Human resource officers, 2 clinic officers, 3 workers representatives and a management representative. The results in Table 4.6 showed that there is reduction in injuries and illnesses, reduced lost workdays due to injuries, increased work output, improvement in workers' morale, reduction in medical expenses, reduction in absenteeism and presenteeism, improved worker's health and improved work quality.

Table 4. 6: The benefits as a result of OHS measures

	Number	Percent
Reduction in injuries and illnesses	11	100
Reduced lost workdays due to injuries and illnesses	11	100
Increase in work output	8	73
Improved employee's morale	9	82
Reduction in medical treatment costs	8	73
Reduction in absenteeism and presenteeism	10	91
Improvement in workers' health	7	64
Improved work quality	6	55
	Out of 11	Out of 100

Source: Author's survey, 2020

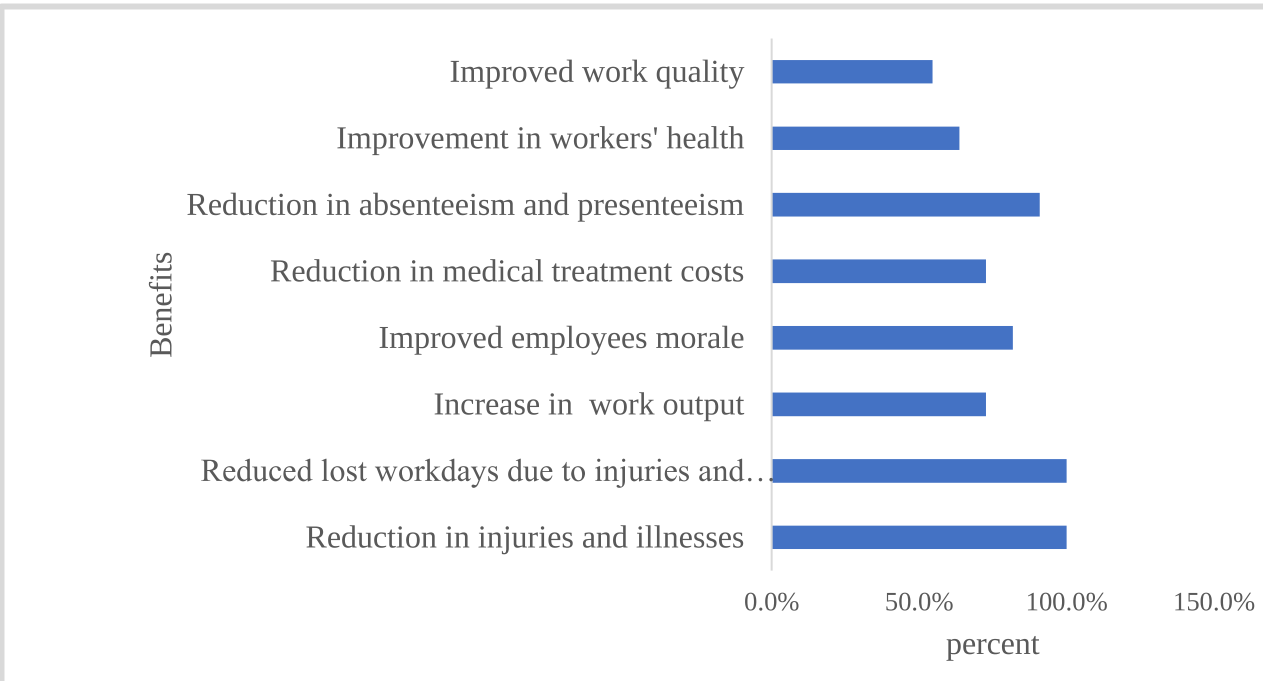


Figure 4. 7: Benefits as a result of OHS measures **(Source**: Author's survey, 2020)

Figure 4.7 shows that 100 percent of respondents mentioned reduction in injuries and illnesses, reduced lost workdays as the benefits after implementation of OHS measures. 91 percent of respondents listed reduced absenteeism and presenteeism, improved morale of workers was given by 82 percent. 73 percent highlighted increased work output and decreased medical treatment costs. Improvement of workers' health was mentioned by 64 percent and 55 percent gave improved work quality.

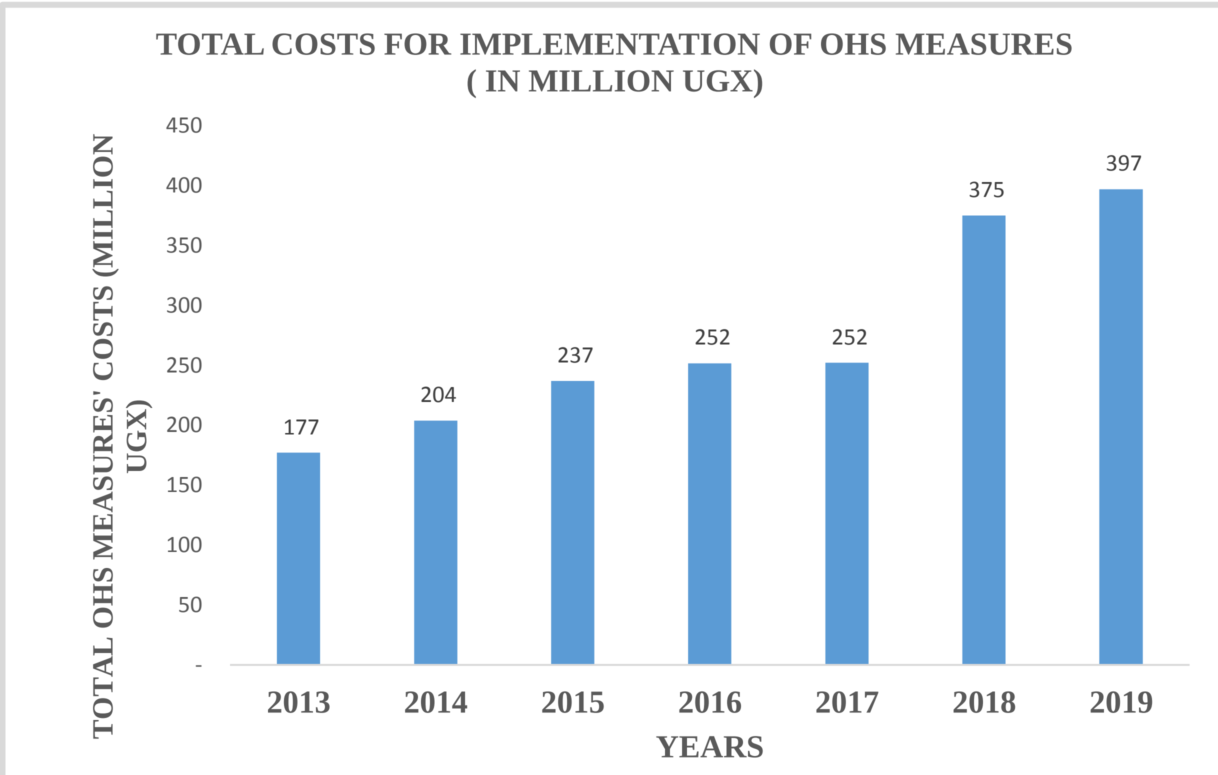


Figure 4. 8: Total costs for OHS measures between 2013 and 2019 (ugx)

Source: Author's survey, 2020

Figure 4.8 displays the total costs for OHS preventive measures; this is analysis of the data in Table 4.2. There is a remarkable continuous increase in annual costs for the OHS preventive measures from 2013 to 2019.There is an increase of 59,795,735 (ugx) a 25 percent increase from 2013 to 2015, 15,277,051 (ugx) a 6 percent increase between 2015 and 2017 and 144,972,812 (ugx) a 37 percent increase between 2015 and 2018. This is a clear indication of incremental investment in occupational health and safety measures. The variation in percent increase could be due to fluctuations in population that was observed in the period of study. Also, for years without ISO certification and recertification the costs are lower. The ISO certification for OHS management system was attained in 2015 for Plant 3 and recertification in 2018.

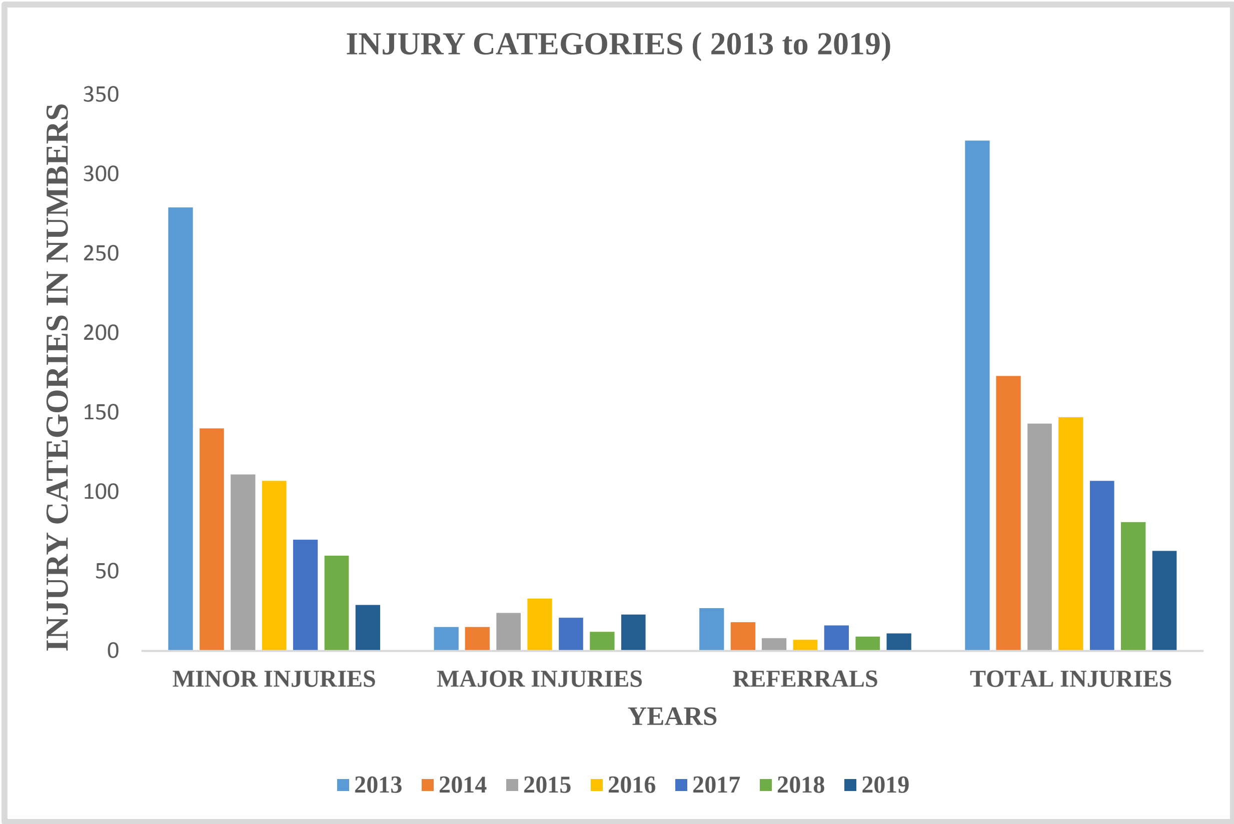


Figure 4. 9: Injury categories in numbers between 2013 and 2019

Source: Author's survey, 2020

Figure 4.9 displays the different injury categories that were recorded at the company clinic between 2013 and 2019. This is analysis of the data on incident cases from table 4.3. There is a significant decrease in the total injuries for each category from 2013 to 2019. The slight increase in injuries for 2016 could be attributed to the new employees that were recruited in that year; fluctuations in population could be the cause but the numbers still remain lower when compared to 2013 before the ISO certification of the main Plant 3.

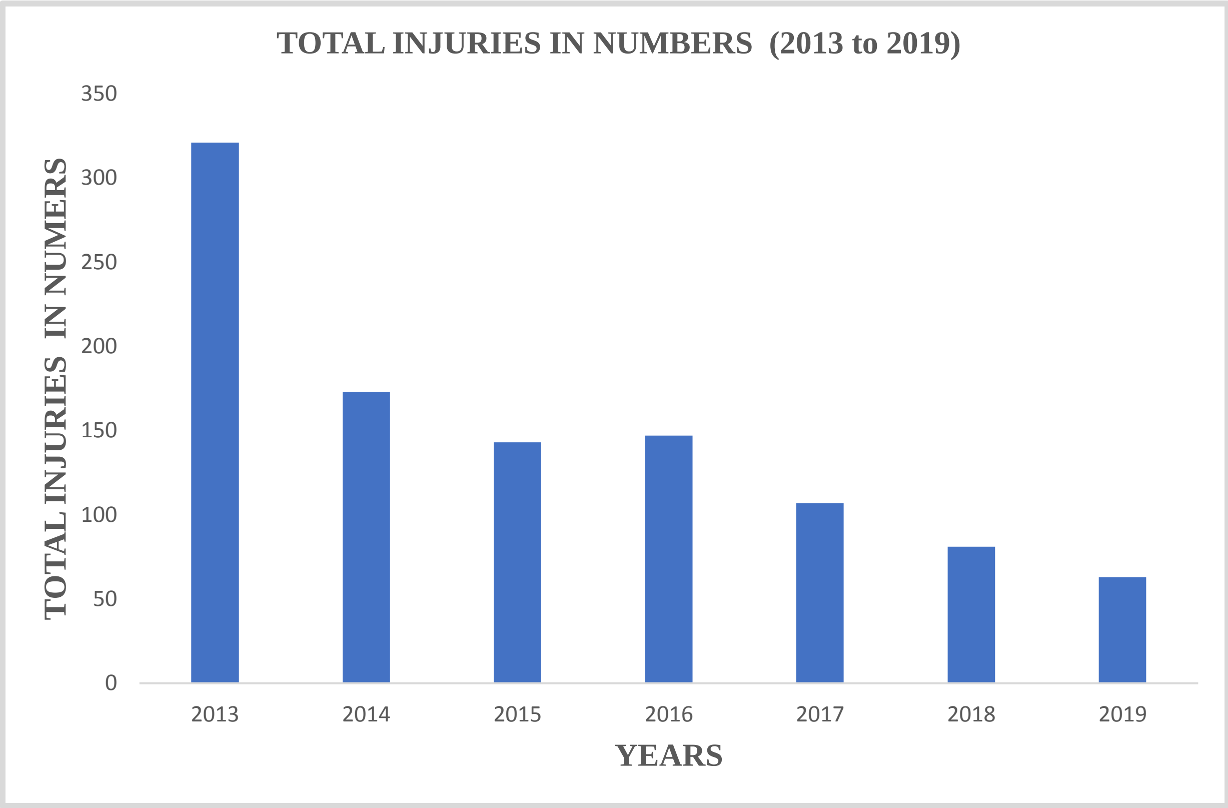


Figure 4. 10: Total injury cases in numbers between 2013 and 2019

Source: Author’s survey 2020

Figure 4.10 shows the total number of injuries between 2013 and 2019; this analysis is based on data in Table 4.3. Figure 4.6 shows a remarkable reduction in injuries from 2013 to 2019. Injury numbers decreased from 321 to 178 from 2013 to 2015, 143 to 107 from 2015 to 2017 and 107 to 63 from 2017 to 2019. Most of the preventive measures were implemented in 2014 and 2015 when ISO Certificate was attained. The reporting culture of incident cases improved after ISO certification and this could be the reason for slight increase in injury numbers in the same year. The observed continuous annual decrease in injury numbers is a direct benefit of the preventive measures that have been put in place to protect the health and safety of workers.

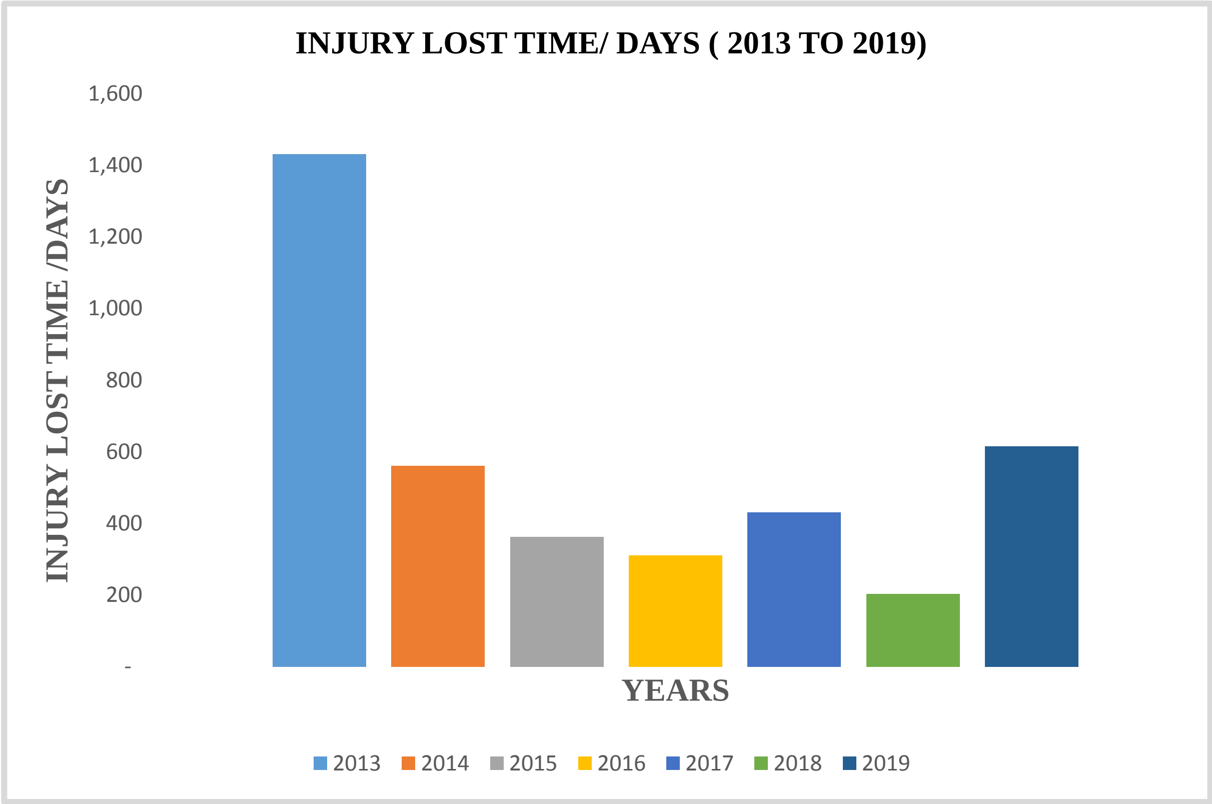


Figure 4. 11: Lost Time Injuries in days between 2013 and 2019

Source: Author's survey 2020

Figure 4.11 displays the injury lost days from 2013 to 2019; there is decrease in the number of days lost due to an injury for the period of study. The analysis is from the data in Table 4.3. The injury lost days decreased from 1431 to 363 (75% reduction) from year 2013 to 2015 and from 363 to 203 (44% reduction) between years 2015 to 2018. The population fluctuations could be the reason for the variations in annual decrease in injury lost days. The observed continuous annual decrease in injury lost days is a direct benefit of the occupational health and safety measures that have been put in place to reduce on incident cases. The 1431 lost workdays for 2013 is equivalent to 2.2 lost workdays per employee.

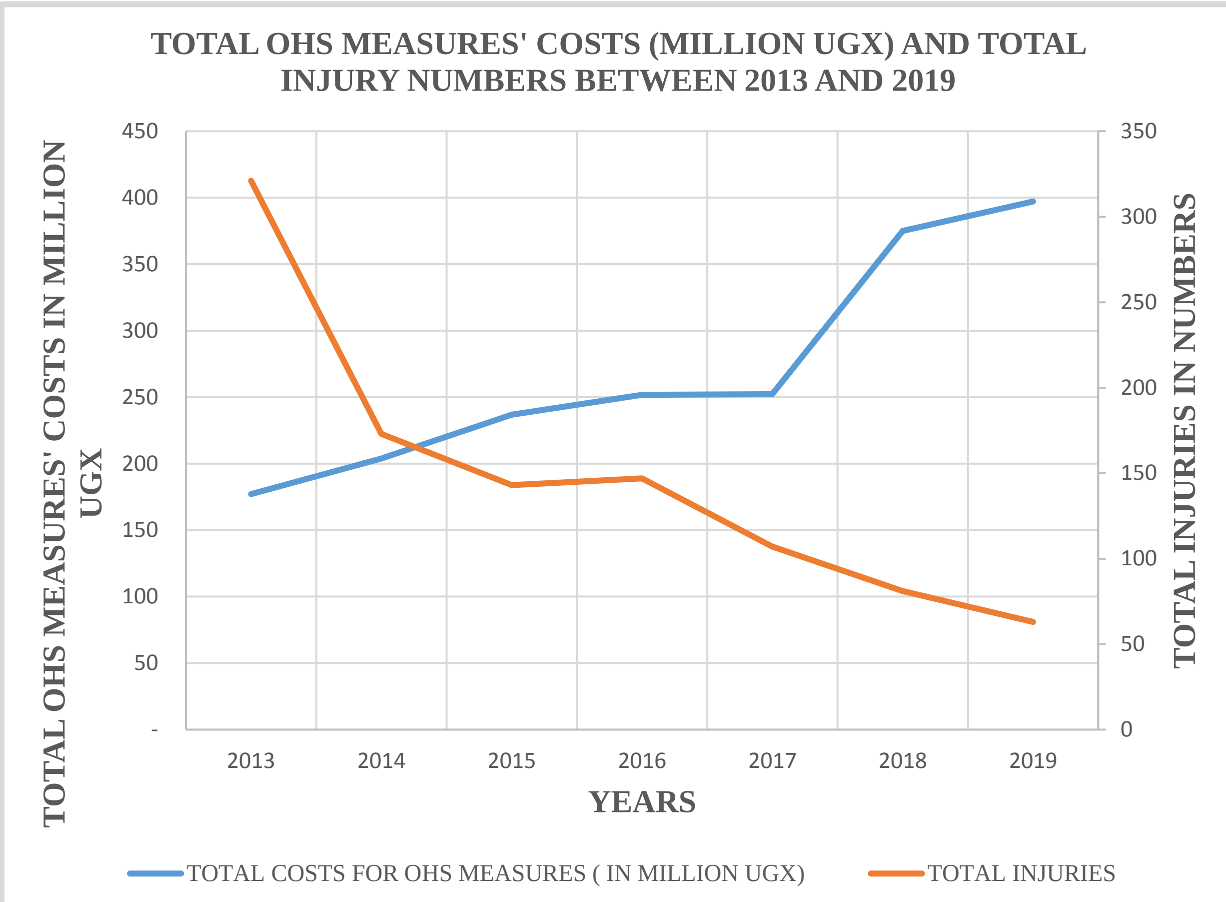


Figure 4. 12: Trend of total costs for OHS preventive measures and total injury cases

Source: Author's survey, 2020

Figure 4.12 describes the relationship between the total costs incurred on OHS measures and the total injury numbers between 2013 and 2019. There is continuous annual incremental investment in OHS and a significant decrease in the annual injury numbers for this period of study.

Between 2013 and 2019 there was 25 percent increase in investment in OHS measures and this yielded 55 percent reduction in injury numbers. From 2015 to 2018 there was 37 percent increase in investment in OHS measures which corresponds with 43 percent reduction in injury numbers; the slope for injury numbers is steeper than for costs of OHS measures. This drop in the annual injuries is a direct benefit associated with the occupational health and safety preventive measures that have been put in place.

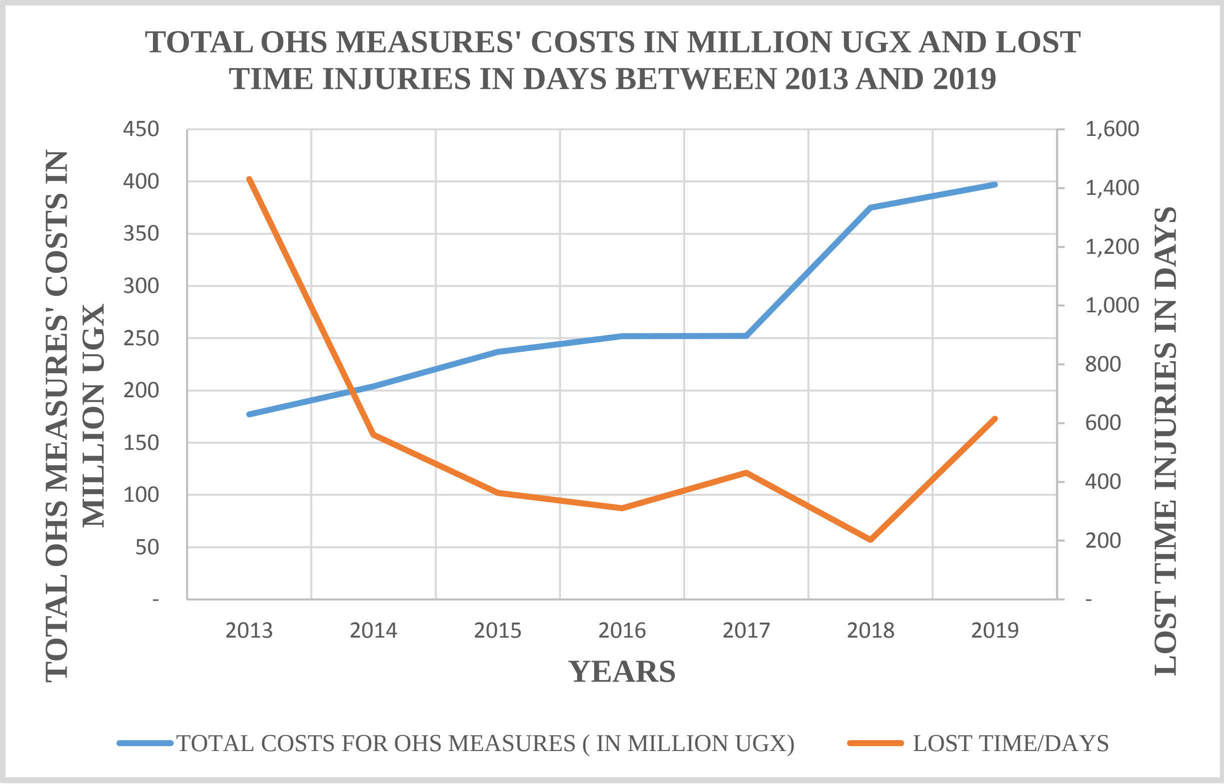


Figure 4. 13: Trends of costs for OHS preventive measures and lost time injuries between 2013 and 2019

Source: Author's survey, 2020

Figure 4.13 analyses the relationship between the OHS intervention measures and the injury lost days. The costs for OHS measures and injury lost days were plotted for the years from 2013 to 2019. The graphs show a continuous decrease in injury lost time with annual incremental investment in OHS. Between 2013 and 2019 there was 25 percent increase in investment in OHS measures and this yielded 75 percent reduction in injury lost days. From 2015 to 2018 there was 36.84 percent increase in investment in OHS measures which corresponds with 44 percent reduction in injury lost days; the slope for lost days is steeper than for costs of OHS measures. This drop in injury lost days is a clear indication of a direct benefit associated with the occupational safety and health preventive measures.

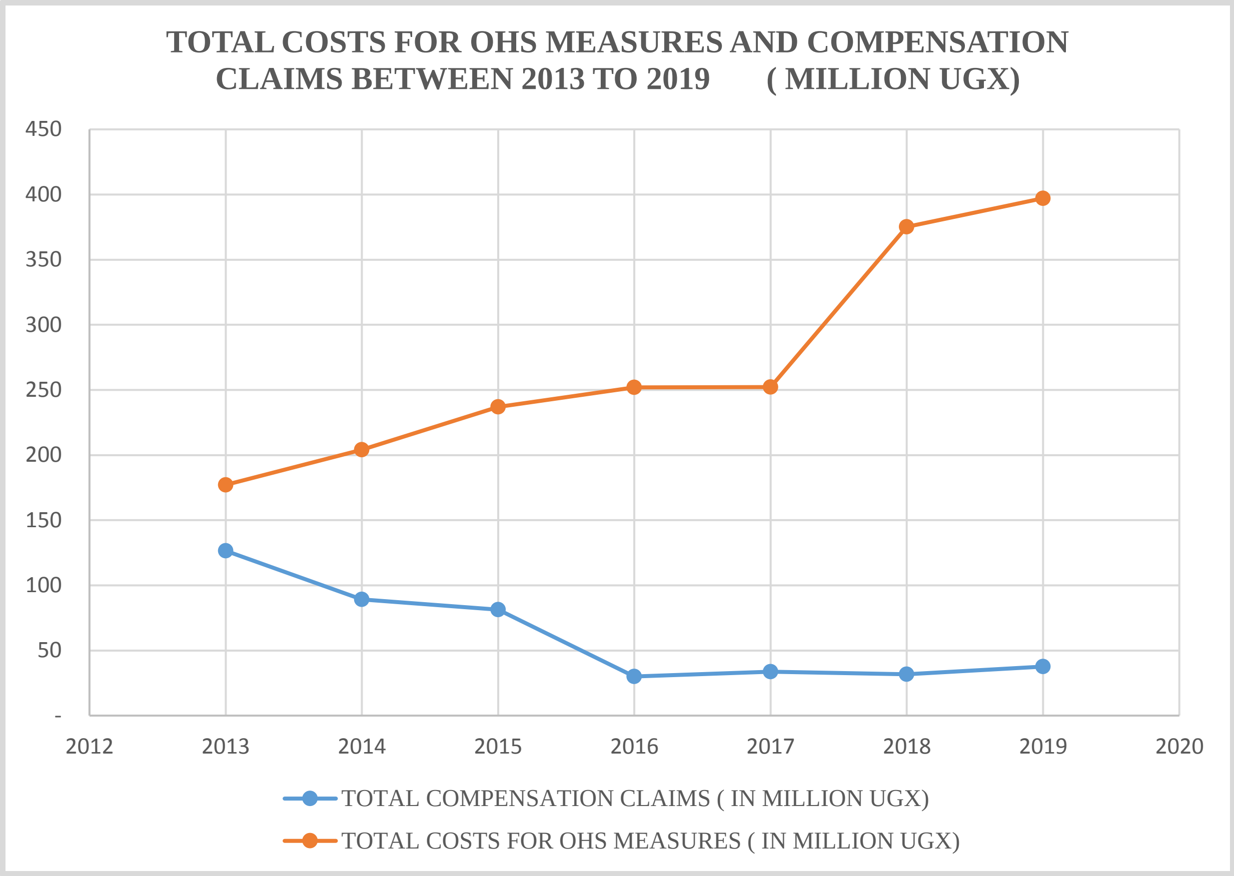


Figure 4. 14: Trend of costs for OHS preventive measures and compensation claims against injury risk between 2013 and 2019

Source: Author's survey, 2020

Figure 4.14 analyses the relationship between the OHS measures and the compensation claims in monetary terms for a period of seven years from 2013 to 2019. This analysis is from the data of Table 4.4 and Table 4.3.It shows remarkable annual decrease in compensation claims with annual incremental investment in OHS measures. The decrease in annual compensation claims is linked to the drop in the annual injuries which is a direct benefit of the incremental investment in OHS measures.

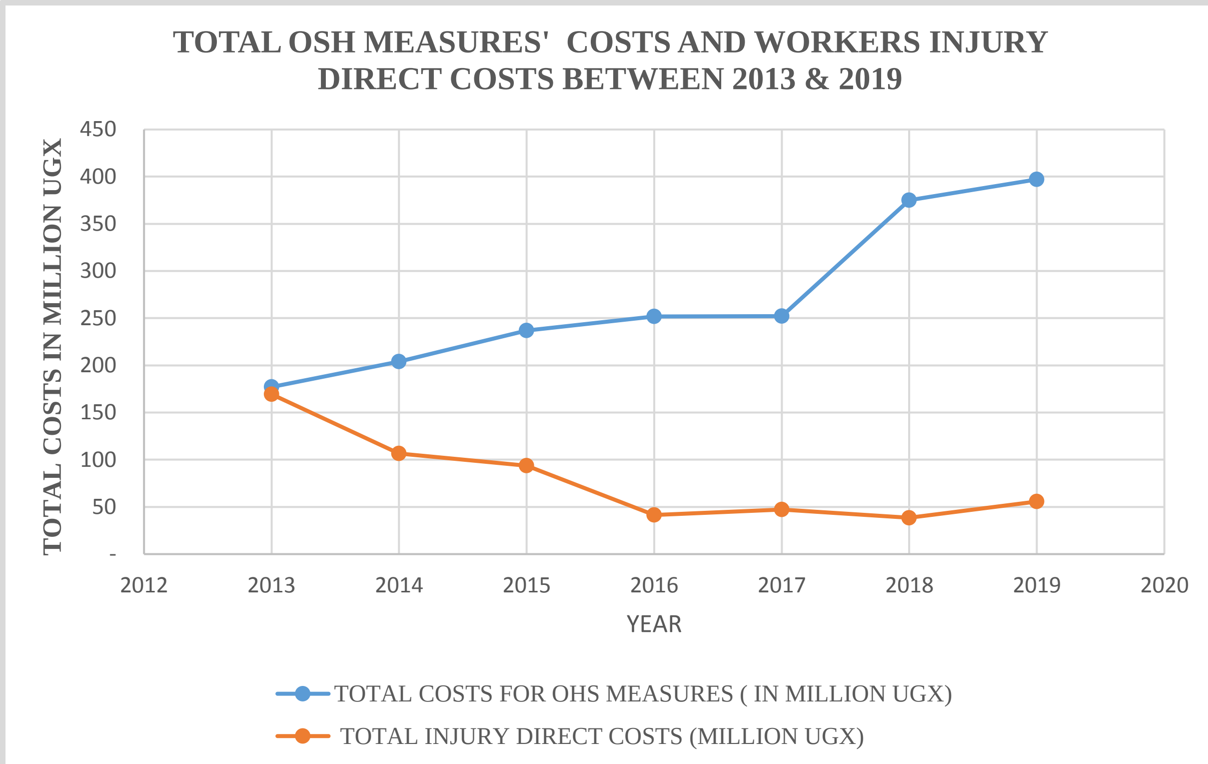


Figure 4. 15: Trend of costs for OHS measures and workers injury direct costs between 2013 and 2019

Source: Author's survey, 2020

From Figure 4.15 there is significant decline in annual injury direct costs with incremental investment in OHS measures. There was 59,795,735 (ugx), (25 %) increase in investment of OHS measures and this yielded 74,538,191 (ugx), (45%) reduction in direct injury costs between 2013 and 2015. Between 2015 and 2017, 6 percent increase in investment in OHS measures corresponded with 50 percent reduction in direct injury costs. This shows that 1 percent increase in investment in OHS measures yields between 2 to 8 percent reduction in injury costs. This reduction in both direct and indirect injury costs is connected to the drop in the number of injuries which is a direct benefit associated with incremental investment in OHS.

According to the American society of safety engineers (2002) for every one dollar ($ 1) invested in health and safety interventions there is a return of eight dollars ($ 8).

This is consistent with other studies for instance Burton (2008) showed that for every one dollar invested in OHS the benefit ranges from $ 1.50 to $ 6.15.

According to the study by Aldana (2001) the return on investment in terms of decrease in medical costs ranges from 1:2.3 to 1:5.9.

Ten other studies show average savings of $ 3.93 for each dollar invested in OHS (Sockoll et-al, 2009)

4.7 The impact of health and safety on employee's productivity

4.7.1 Diagnostic tests.

In this regard Normality test, multicollinearity test and heteroskedasticity test were carried out in this study and the values of Variance Inflation Factor (VIF) and the significance values were presented in Table 4.7. The mean value for VIF and significance value are 0.245 and 2.390 respectively. Since the majority of the significance values and the overall mean value for variables are greater than 0.05, the model is free from the problems of normality and heteroskedasticity. This shows that the data was normally distributed. The VIF values for all variables were less than 10, the levels of multicollinearity were not serious hence the model is free from the problem of multicollinearity; this shows that the regressors are not correlated.

Table 4. 7: Results of diagnostic tests.

Variables	Sig. value	VIF
GENDER	.278	1.034
LOW_RISK	.261	1.246
MEDIUM_RISK	.591	2.441
HIGH_RISK	.210	2.233
SAFETY	.060	3.666
HEALTH	.070	3.730
Mean value	**0.245**	**2.390**

Source: Author's survey, 2020

4.7.2 Univariate regression analysis

In table 4.8 the coefficient estimates show that all regressors are significant in the model. There is a positive correlation between health, safety and the worker's productivity since the coefficient estimates are positive. The level of risk negatively affects the individual's productivity since all their coefficient estimates is negatives. This is explained by the fact that a safe environment creates a conducive atmosphere which increases the vigor of the worker that translates into higher productivity (Akinyele, 2007). Also, the environment becomes less conducive as the level of risk increases and this negatively affects the morale of the workers hence reducing productivity.

The unit improvement in safety and health measures yields incremental change in the worker's level of productivity. In Table 4.8, every unit increase in safety preventive measures causes 23.7 percent marginal increase in the worker's productivity. 42.3 percent marginal increase in the worker's productivity is caused by a unit improvement in health.
This is consistent with other studies for instance lambert (2005) which showed that productivity is hindered by ineffective management of the working environment.

Males are productive in the model than females; the coefficient estimate for gender is negative. Since males were code zero, this shows that productivity increases more when a male is added in the workforce than when a female is added. The Unit increase change in any level of risk causes a marginal loss in the level of one's productivity. In table 4.8 the change from low risk to medium risk causes 21.7 percent marginal loss in the employee's level of productivity. The change from medium risk to high risk causes a marginal loss of 12.5 percent in the level of productivity for the worker and an increase in the high-risk level causes 29.1 marginal loss in one's level of productivity.

Table 4. 8: coefficient estimates of regressors from univariate regression analysis

variables	Coefficient estimates (B)	Std. Error	T
(Constant)	5.240	.300	17.474
GENDER	-.289	.266	-1.087
LOW_RISK	-.217	.192	-1.128
MEDIUM_RISK	-.125	.232	-.539
HIGH_RISK	-.291	.232	-1.258
SAFETY	.237	.085	2.793
HEALTH	.423	.092	4.586

Source: Author's survey findings, 2020

From these parameter estimates of the univariate regression analysis, the empirical model becomes;

$$Y = \beta_0 + \beta_1 \text{GENDER} + \beta_2 \text{LOW RISK} + \beta_3 \text{MEDIUM RISK} + \beta_4 \text{HIGH RISK} + \beta_5 \text{HEALTH} + \beta_6 \text{SAFETY}$$

$$\mathbf{Y = 5.240 - 0.289 * GENDER - 0.217 * LOW\_RISK - 0.125 * MEDIUM\_RISK - 0.291 * HIGH\_RISK + 0.423 * HEALTH + 0.423 * SAFETY}$$

Table 4. 9: Output model summary

Model Summary			
Model	R Square	Adjusted R Square	Std. Error of the Estimate
1	.489	.474	1.05967

Source: Author's survey findings, 2020

From Table 4.9 the coefficient of determination (R square) is 0.49 which shows that productivity is 49 percent influenced by the regressors and the rest 51 percent is explained by other causes.

Table 4. 10: Mean values of the measures of productivity

Descriptive Statistics			
	Mean	Std. Deviation	N
PRESENCE	6.8269	2.02135	208
WORK_QUALITY	6.8413	2.00695	208
WORK_OUTPUT	6.8462	1.99888	208
MORALE	6.8221	2.00292	208

Source: Author's survey findings, 2020

Table 4.10: Shows that the average attendance rate is 6.83 which is 68.3 percent of what is required from the employee. The non-reporting rate of 31.7 percent could be due to unsafe and unhealthy state of the employees.

Court (2003) findings show that the health interventions greatly reduced the injuries and absenteeism and this led to higher productivity. Similar studies by Slivan et-al (2001) show positive correlation between promotion of health and safety interventions and the productivity as a result of remarkable reduction in absenteeism.

The average quality of the employee's work was 68.4 percent. The quality of one's work is affected by many factors but the health and safety status of the workers affects also.
The average work output from the employees is at 68.5 percent of what is required from the best performer. The incomplete work could be due to health status of the employee and unsafe working environment though they could be some other factors.

The average morale level of the employees is 68.2 percent; when the working environment is not conducive because of unsafe conditions, the workers' vigor for work reduces.
Similar findings are in support for instance by American society of safety engineers (2002) on establishing the link between the health and safety interventions and productivity; which reveal that productivity is positively influenced by the health and safety intervention measures.

Table 4. 11: Multivariate regression analysis parameter estimates

Parameter Estimates							
						95% Confidence Interval	
Dependent Variable	Parameter	B	Std. Error	T	Sig.	Lower Bound	Upper Bound
PRESENCE	Intercept	1.279	.356	3.591	.000	.577	1.981
	GENDER	.020	.315	.063	.950	-.602	.642
	LOW	-.181	.228	-.795	.428	-.630	.268
	MEDIUM	-.233	.276	-.845	.399	-.777	.311
	HIGH	-.024	.275	-.088	.930	-.566	.518
	HEALTH	.762	.110	7.010	.070	.552	.984
	SAFETY	.278	.101	2.757	.085	.079	.476
WORK_QUALITY	Intercept	1.281	.347	3.689	.000	.596	1.966
	GENDER	.005	.308	.016	.987	-.602	.612
	LOW	-.194	.222	-.873	.384	-.632	.244
	MEDIUM	-.238	.269	-.886	.377	-.769	.292
	HIGH	-.004	.268	-.014	.989	-.532	.525
	HEALTH	.766	.107	7.168	.060	.555	.977
	SAFETY	.282	.098	2.867	.075	.088	.475
WORK_OUTPUT	Intercept	1.289	.343	3.763	.000	.614	1.965
	GENDER	.001	.304	.002	.998	-.598	.599
	LOW	-.206	.219	-.938	.349	-.638	.227
	MEDIUM	-.250	.265	-.940	.348	-.773	.274
	HIGH	-.006	.265	-.023	.982	-.528	.516
	HEALTH	.766	.105	7.266	.076	.558	.974
	SAFETY	.283	.097	2.918	.090	.092	.474
MORALE	Intercept	1.321	.353	3.740	.000	.624	2.017
	GENDER	.026	.313	.083	.934	-.591	.643
	LOW	-.175	.226	-.774	.440	-.621	.271
	MEDIUM	-.220	.274	-.802	.423	-.759	.320
	HIGH	-.022	.273	-.082	.934	-.560	.515
	HEALTH	.767	.109	7.059	.125	.553	.982
	SAFETY	.268	.100	2.684	.150	.071	.465

Source: Author’s survey, 2020

4.7.3 Multivariate regression analysis results

From the multivariate parameter estimates, all productivity measures increase with a marginal increase in health while keeping all regressors constant. The levels of influence were significant at 5 percent level. These findings are in agreement with the study made by Webb (1989) which show that the delivery capacity of an individual is dependent on his health status. Implementation of the health intervention measures directly reduce the absenteeism rate and indirectly increases one's morale, volume and quality of work. The level of influence of health on the productivity measures slightly differed in the parameter estimates. It is clear that the individual's work quality, work output and morale benefit more from the implementation of the health interventions while his or her attendance benefits least. This is explained by the fact someone can be still at work with sickness but the work quality, morale and work output of such an individual could be low.

From the coefficient estimates, the following marginal influences are caused on the productivity measures by marginal improvement in health intervention measures; both work quality and quantity increase by 76.6 percent, the morale of employee increases by 76.7 percent while the attendance improves by 76.2 percent. Table 4.11 also shows that marginal increase in the safety interventions directly causes marginal increments in each productivity measure.

These findings were comparable with past studies carried on in developed and middle-income countries. For instance, the findings were consistent with the observations made by Webb (1989) and Macleod (1995), Webb (1989) observed a huge percent increment in the level of productivity after physical and mechanical modifications were made with an intent of improving the safety of workers in an organization. Webb (1989) showed that the physical and mechanical changes at the workplace caused 1000 percent increase in productivity in a period of less than three months.

The marginal increments in the productivity measures due to a unit increase in safety are as follows; 27.6 percent for one's presence, 28.2 percent for work quality, 28.3 percent for individual's work output and 26.8 percent for one's morale. Workers with low levels of morale do not perform to their supreme potential. Accidents have a withering effect on the workers' morale. When a worker is injured, her or his fellow employees mutely think, "that would have been me," this is addition to worrying about the worker. This becomes more devastating if the injured worker is more liked and well known in the organization (Blumenstein et-al., 2011).

Gender and high level of risk are less significant in the model since their coefficient estimates are very low hence were excluded in the model.

From equation (3.4)

$$Y = \beta_0 + \beta_1 * \text{GENDER} + \beta_2 * \text{LOW RISK} + \beta_3 * \text{MEDIUM RISK} + \beta_4 * \text{HIGH RISK} + \beta_5 * \text{HEALTH} + \beta_6 * \text{SAFETY}$$

Worker's Attendance

Y_1 = 1.279 - 0.181*LOW_RISK - 0.233*MEDIUM_RISK+0.762*HEALTH+0.278*SAFETY.

Quality of Work

Y_2 = 1.281-0.194*LOW_RISK -0.238*MEDIUM_RISK+0.766*HEALTH+0.282*SAFETY.

Work output

Y_3 = 1.289-0.206*LOW_RISK -0.250*MEDIUM_RISK+0.766*HEALTH+0.283*SAFETY.

The worker's morale

Y_4 = 1.321-0.175*LOW_RISK -0.220*MEDIUM_RISK+0.767*HEALTH+0.268*SAFETY.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The findings of the study show that the occupational health and safety measures had been implemented with an intent of protecting the worker while executing his or her duties. These measures majorly fall under the administrative controls and engineering controls. The current level of implementation of OHS measures stands on average of 60 percent.

There is a remarkable decrease in the number of injuries and lost workdays and this translates into a significant reduction in the injury treatment costs. This is linked to be direct benefits of the occupational Health and safety measures. The findings show that for every one percent increase in OHS measures, the benefit in terms of reduction in direct injury costs is between 2 to 8 percent.

The findings show that marginal increase in the safety and health interventions directly causes marginal increments in each productivity measure. Health and safety interventions positively impact on one's attendance at work, quality of work, work output, and the morale. Another significant finding from the analysis is that, the level of risk associated with individual's work inversely affects one's delivery potential.

It is crystal clear from findings that the proactive management of safety and health in the workplace helps organizations prevent injuries and ill-health at work. Improvements in working conditions generally had a beneficial effect on productivity.

From these study findings we therefore conclude that the expenditure associated with the preventive measures should not be looked at as a cost but as an investment. Both direct and intangible benefits are linked to the OHS intervention measures. Even though cost savings are a motivator, safety's biggest return on investment may be human capital. Employers should not base decisions on whether a particular change will result in cost savings, but instead on whether it will keep workers safe.

5.2 Recommendation

From the study findings I recommend the following for the steel industry sector;
The medical insurance cover should be extended to all workforce. This will promote the well-being of all the workers and reduce on the constraint of demand for health care. The level of worker's productivity will improve greatly.

The management of health and safety systems in the steel manufacturing organizations should be proactive to prevent injuries, all incident cases and ill-health at work. The findings show that the accident costs are dearly expensive but looking at prevention costs makes an economic sense.

5.2.1 Recommendation for further research

Further research should be done to investigate the impact of occupational health and safety across different manufacturing sectors on the employee's performance and the employer.

REFERENCES

Abdel, M., Mahrous, A., Abou, E., Batanony, A., & Allam, K. (2009). Auditory and respiratory health disorders among workers in an iron and steel factory. Zagazig Journal of Occupational Health and Safety, 2(1).

Alli & Benjamin, O. (2008). Fundamental principles of occupational health and safety (Second edition). Geneva: International Labour Organization, 2008.

Akinyele, T. (2007). Needs satisfaction: An effective tool for workers commitment to work. Research Journal of Business Management, 1(1), 72-79.

Aldana, G. (2001). Financial impact of health promotion programs: a comprehensive review of the literature. American Journal of Health Promotion, 15(5), 296-320.

ASSE. (2002)**.** White paper addressing the return on investment for safety, health and environmental management programmes, the American society of safety engineers.

Bankole, A. (2012). Perceived influence of health education on occupational health of factory workers in Lagos State, Nigeria. British Journal of Arts and Social Sciences 8(1):57-65.

Bardhylka,K. (2016).Occupational Health and Safey Policy Document. Albania: ILO.

Barreto. M., Swerdlow, J., Smith, P. G., & Higgins, D. (1997). A nested case-control study of fatal work-related injuries among Brazilian steel workers. Occupational and Environmental Medicine, 54(8), 599-604.

Beyer, H. (2002) CRC Standard Mathematical Tables, 31st ed. Boca Raton, FL: CRC Press, pp. 536 and 571, 2002.

Bilga, S., & Chohan, S. (2011). Occupational health hazards in small scale steel manufacturing industries. International Journal of Manufacturing Technology and Management, 182-192.

Bose, S., Lettmeier, B., Cao, L., Siebert, U., Tesha, A., Pronczuk, J., & Drasch, G. (2007). Health and environmental training in mercury-contaminated areas. International Journal of Environment and Health, 1(4), 621-637.

Blumenstein, Ferriter, R., jerry & Michelle (2011) “guide for estimating the total cost of accident” Colorado school of mines, USA

Burton, J. (2008). The business case for a healthy workplace. Mississauga, Canada: Industrial Accident Prevention Association, 2008

Cherry, N., Meyer, D., Adisesh, A., Brooke, R., Owen, V., Swales, C., & Beck, H. (2000). Surveillance of occupational skin disease: Epiderm and Opra. British Journal of Dermatology, 142(6), 1128-1134.

Cochran, G. (1977). Sampling techniques (3rd ed.). New York: John Wiley & Sons.

Court, S., (2003). Work and enterprise panel of enquiry: links between the quality of working life and productivity: HSE, London.

DOHS.(2016). Enforcement of Occupational safety and Health activities at workplace. Kampala: Auditor General

Lulewicz, A. (2010). An OH&S management system as a source of information. International Journal of Occupational Safety and Ergonomics, 16(4), 445-454.

Gbadago, P., Amedome, N., & Honyenuga, Q. (2017). The impact of occupational health and safety measures on employee performance at the South Tongu District Hospital. Global Journal Inc. (USA), 17(5), 13-19.

Gagne, R. (2011). What does a workplace injury cost? Direct versus indirect costs and their affect to the bottom line. Fit2WRK Clinical Educational Series, 1.

Guilbert, J. (2002). The world health report: reducing risks, promoting healthy life. Education for health, 16(2), 230-230.

.International Labour Organisation. (2005). Code of Practice on Safety and Health in the Iron and Steel Industry: Meeting of Experts to Develop a Revised Code of Practice on Safety and Health in the Iron and Steel Industry, Geneva, 2005. ILO.

ILO. (2015). global trends on oocupational accidents and diseases. geneva: world day for health and Safety at work,28 april 2015.

ILO. (2019). safety and health at workplace. Retrieved from ILO: https://www.ilo.org/global/topics/safety-and-health-at-work/lang--en/index.htm

ISO. (2018). BS ISO 45001:2018. Switzerland: BSI.

Krejcie,V., & Morgan, W. (1970). Determining sample size for research activities. Educational and psychological measurement, 30(3), 607-610.

Lambert, S. (2005). Added Benefits: The Link between work life benefits and organizational citizenship, Acad. Manage. J. 43: 5.

Lambert, J. (2000). Added benefits: The link between work-life benefits and organizational citizenship behavior. Academy of management Journal, 43(5), 801-815.

Leigh, P. (1995). Smoking, self-selection and absenteeism. The Quarterly Review of Economics and Finance, 35(4), 365-386

Mojapelo, J., & Kok, L. (2017). Adherence to occupational health and safety standards: the case of a South African steel processing company. African Journal of Governance & Development, 6(1), 51-71.

Mekkodathil, A., Menyar, A., & Thani, H. (2016). Occupational injuries in workers from different ethnicities. International journal of critical illness and injury science, 6(1), 25.

Mentzakis, E., & Delfino, D. (2010). Effects of air pollution and meteorological parameters on human health in the city of Athens, Greece. International Journal of Environment and Pollution, 40(1-3), 210-225.

Mcphail, D. (2009). Canada Weighs in Gender, Race, and The Making of Obesity (Doctoral dissertation, York University, Toronto).

Macleod .(1995). How Health and Safety Makes Good Business Sense , 2008

Mankiw,P., Yun, Y., Manickam, K. (2007). The Impact of Occupational Health and Safety Measures on Employee Performance at the South Tongu District Hospital. Global Journals Inc. (USA), 2249-4618.

Mazaheri, A., Hidarnia, Ghofranipour, & Zade. (2009). Occupational injuries in Isfahan Steel Company during 2001-2006. Eur J Sci Res, 31(4), 546-52.

Mostafa, A. (2003). Study of the measurement of labour productivity in the Palestinian construction industry: the Gaza strip, Islamic university of Gaza- Palestine

National Safety Council. (2005). injury facts. USA: National safety council,2006.

National safety council. (2019). injury Facts, Bureau of Labour Statistics NSC, USA.

Nigel, Z. (2006). Challenges to temperature regulation when working in hot environment. Industrial health, 331-344.

Pandit, K., & Tiwari, R. (2008). Morbidity profile of steel pipe production workers. Indian journal of occupational and environmental medicine, 12(2), 88.

Rafiei, M., Gadgil, S., Ghole, S., Jaafarzadeh, N., Gore, D., Aberomand, M., & Shabab, M. (2008). Investigation of respirable particulate matter pollutants on air-breathing zone workers in the Beam Rolling Mills Factory (Iran National Steel Industrial Group), Ahvaz, Iran. Indian journal of occupational and environmental medicine, 12(2), 71.

Singh, P., Bhardwaj, A., & Deepak, K. (2010). Occupational exposure in small and medium scale industry with specific reference to heat and noise. Noise and Health, 12(46), 37.

Stanford University. (1982). Improving construction safety performance. Department of Civil Engineering Technical Report No. 260.

Sockoll, I., Kramer, I., & Bödeker, W. (2009). Effectiveness and Economic Benefits of Workplace Health Promotion and Prevention: Summary of the Scientific Evence 2000 Bis 2006. Federal Association of Company Health Insurance Funds..

Thiede, I., & Thiede, M. (2015). Quantifying the costs and benefits of occupational health and safety interventions at a Bangladesh shipbuilding company. International journal of occupational and environmental health, 21(2), 127-136.

Takala, J., Hämäläinen, P., Saarela, L., Jin, W., & Lin, S. (2014). Global estimates of the burden of injury and illness at work in 2012. Journal of occupational and environmental hygiene, 11(5), 326-337.

Takele & Mengesha . (2006). lecture notes for envirnonmental and occupational health students. occupational safety and health. ethiopia: Takele Tadesse and Mengesha Admassu Health Training Initiative, 2.

Webb, T. (1989). How health and safety makes good business sense. Retrieved June, 15, 2015.

Weil,G., Romer, N. (1992). a contribution to the empirics of economic growth, quarterly journal of economics 107:407-437

World Health Organization. (1995). Global Strategy on occupational health for all. The way to health at work. http://www. who. int/occupational_health/globstrategy/en.

World Health Organization. (1996). National and international strategies to improve the work environment and workers' safety and health: report on a WHO planning group, Prague, Czech Republic, 7-9 December 1995 (No. EUR/ICP/OCH 152 RB (2)(A)). Copenhagen: WHO Regional Office for Europe.

World Health Organization. (2010). World health statistics. World Health Organization.

World Health Organization. (2013). WHO global plan of action on workers health (2008-2017). In WHO global plan of action on workers health (2008-2017).

World Health Organization. (2016). Global strategy on human resources for health: Geneva, WHO

World Health Organization. (2002).Reducing Risks and Promoting health life. Geneva. WHO

Wheelan, C. (2014). Naked Statistics. W. W. Norton & Company

APPENDICES

1.0 Regression model summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.699[a]	.489	.474	1.05967

a. Predictors: (Constant), HEALTH, GENDER, HIGH, LOW, MEDIUM, SAFETY

1.1 ANOVA results

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	216.176	6	36.029	32.086	.000[b]
	Residual	225.703	201	1.123		
	Total	441.880	207			

a. Dependent Variable: productivity

b. Predictors: (Constant), HEALTH, GENDER, HIGH, LOW, MEDIUM, SAFETY

1.3 univariate regression analysis results

Coefficients[a]								
		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	5.240	.300		17.474	.000		
	GENDER	-.289	.266	-.056	-1.087	.278	.967	1.034
	LOW	-.217	.192	-.063	-1.128	.261	.803	1.246
	MEDIUM	-.125	.232	-.042	-.539	.591	.410	2.441
	HIGH	-.291	.232	-.095	-1.258	.210	.448	2.233
	SAFETY	.237	.085	.270	2.793	.060	.273	3.666
	HEALTH	.423	.092	.447	4.586	.070	.268	3.730

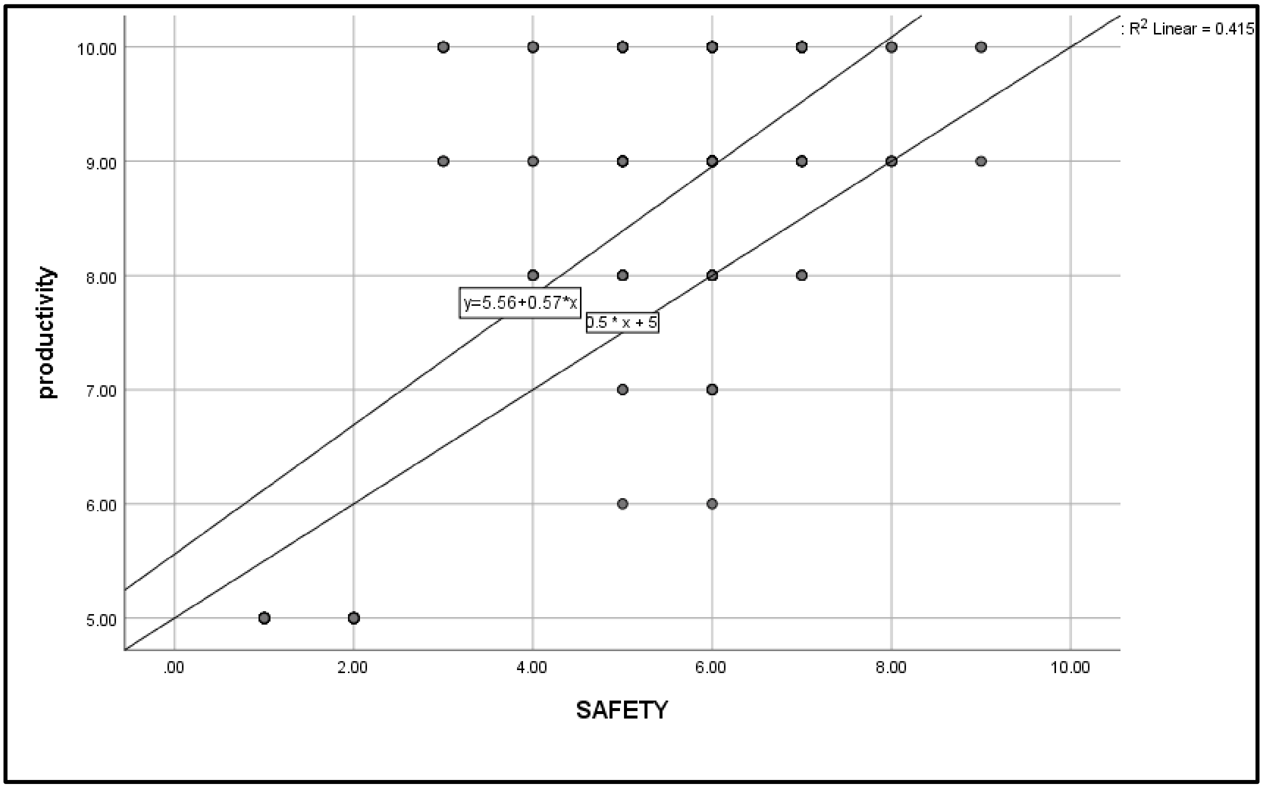
a. Dependent Variable: productivity

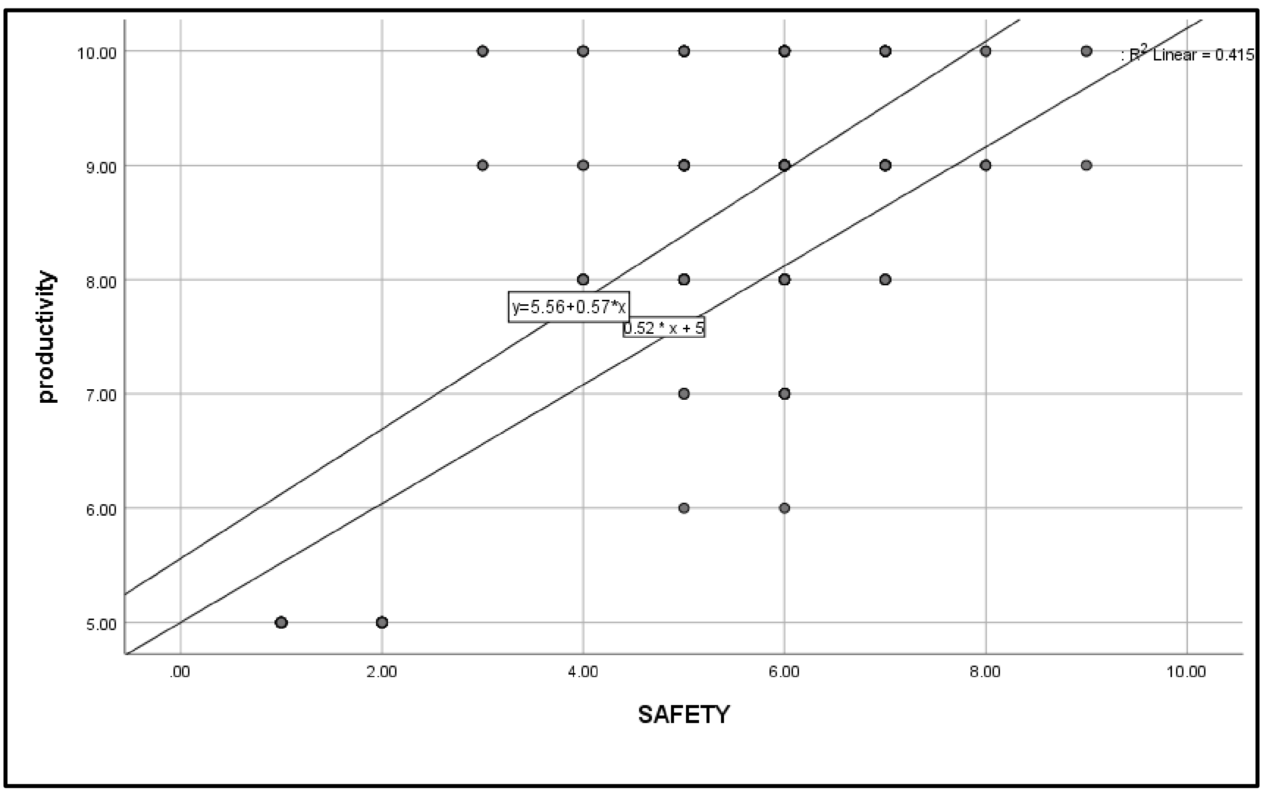
1.4 Multivariate regression analysis results

Parameter Estimates

Dependent Variable	Parameter	B	Std. Error	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
PRESENCE	Intercept	1.279	.356	3.591	.000	.577	1.981
	GENDER	.020	.315	.063	.950	-.602	.642
	LOW	-.181	.228	-.795	.428	-.630	.268
	MEDIUM	-.233	.276	-.845	.399	-.777	.311
	HIGH	-.024	.275	-.088	.930	-.566	.518
	HEALTH	.768	.110	7.010	.070	.552	.984
	SAFETY	.278	.101	2.757	.085	.079	.476
WORK_QUALITY	Intercept	1.281	.347	3.689	.000	.596	1.966
	GENDER	.005	.308	.016	.987	-.602	.612
	LOW	-.194	.222	-.873	.384	-.632	.244
	MEDIUM	-.238	.269	-.886	.377	-.769	.292
	HIGH	-.004	.268	-.014	.989	-.532	.525
	HEALTH	.766	.107	7.168	.060	.555	.977
	SAFETY	.282	.098	2.867	.075	.088	.475
WORK_OUTPUT	Intercept	1.289	.343	3.763	.000	.614	1.965
	GENDER	.001	.304	.002	.998	-.598	.599
	LOW	-.206	.219	-.938	.349	-.638	.227
	MEDIUM	-.250	.265	-.940	.348	-.773	.274
	HIGH	-.006	.265	-.023	.982	-.528	.516
	HEALTH	.766	.105	7.266	.076	.558	.974
	SAFETY	.283	.097	2.918	.090	.092	.474
MORALE	Intercept	1.321	.353	3.740	.000	.624	2.017
	GENDER	.026	.313	.083	.934	-.591	.643
	LOW	-.175	.226	-.774	.440	-.621	.271
	MEDIUM	-.220	.274	-.802	.423	-.759	.320
	HIGH	-.022	.273	-.082	.934	-.560	.515
	HEALTH	.767	.109	7.059	.125	.553	.982
	SAFETY	.268	.100	2.684	.150	.071	.465

1.5 Linear Correlationship





1.5 Questionnaire format

PARTICIPANTS QUESTIONNAIRE

Date……………………………………….

Dear Respondents,

I am a master's student at Kyambogo University. I am collecting data for my dissertation regarding **"Impact of Investment in Occupational Health and Safety on a Steel Manufacturing Plant in Uganda".**

I will be very grateful if you could honestly give responses to the following questions.

Kindly be assured that information provided would not in any way be linked to you and would be treated with utmost confidentiality

Yours faithfully,

BWENGYE INNOCENT

DEMOGRAPHIC INFORMATION

Please tick your gender:

Male [ ] **Female** [ ]

1. Tick the plant (phase) and department that you belong to;

(a) department

Mechanical [ ] Electrical [ ] Common/ administration [ ]

Raw materials and store [ ] Production [ ]

(b) Plant/ phase

Phase **1** [ ] Phase **2** [ ] Phase **3** [ ]

2. **Category of work**

Manager [ ] Supervisor [ ] Others (Specify)……………………………………………

3. RISK LEVEL

Kindly tick the level of health and safety hazards/risks that you usually encounter with your working area

(a) Low [ ] (b) Medium [ ] (c) High [ ]

4. LEVEL OF INVESTMENT IN HEALTH AND SAFETY

(a) In your view what is the level of investment in preventive measures to protect your health at your workplace in your organization. (Assess with a scale of 1 to 10 by **circling** appropriately).

1 2 3 4 5 6 7 8 9 10

(b) Kindly assess the level of investment in preventive measures to maintain the standard level of safety at your workplace in your organization (Assess with a scale of 1 to 10 by circling appropriately

1 2 3 4 5 6 7 8 9 10

5. IMPORTANCE OF HAVING HEALTH AND SAFETY PROGRAMMES TOWARDS EMPLOYEES' PERFORMANCE

(1) How has health and safety measures affected/influenced the following productivity measures in your organization; (using a scale of 1 to 10 **circle** appropriately)

a) **Your presence at work (attendance)**

1 2 3 4 5 6 7 8 9 10

(Very little...…………………………………………………………. ……very large)

b) **Your work Quality**

1 2 3 4 5 6 7 8 9 10

(Very little...…………………………………………………………. ……very large)

c) **Your work output**

1 2 3 4 5 6 7 8 9 10

(Very little...…………………………………………………………. ……very large)

d) **Your level of morale at work**

1 2 3 4 5 6 7 8 9 10

(Very little...…………………………………………………………. ……very large)

(2) How would you rate your work performance if health and safety hazards/challenges were not associated with your work? Using a scale of 1 to 10 where 1 is for lowest performer while 10 is for the best performer. (**Circle** appropriately)

1 2 3 4 5 6 7 8 9 10

(Very low...……………………………………………………………..……very high**)**

RECOMMENDATIONS

1. In your own view, what do you think the management should do to improve the health and safety system for the benefit of both individual employees and the company at large?

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

…………………………………………………………………….

Thanks for your time and participation; this information will be treated with confidentiality and will be used for academic purposes only.

1.6 Krejecie and Morgan sample size table

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

1.7 Acceptance Letter

ROOFINGS

RRM

MR. BWENGYE INNOCENT,
Department of Mechanical & Production Engineering,
Kyambogo University,
Kampala, Uganda

Saturday 12th September,2020

Dear Innocent,

RE: PERMISSION TO CONDUCT RESEARCH AT RRM PLANT

The above matter refers.

Ms. Roofings Rolling Mills Limited is in receipt of a communication from your end, requesting for an opportunity to conduct research at our plant ***i.e. "Impact of Investment in Occupational Safety & Health on a Steel Manufacturing Plant in Uganda – Roofings Rolling Mills Limited"***. A copy of the recommendation letter from Kyambogo University dated Tuesday 8th September,2020 is enclosed for your kind perusal and consideration.

To that end, we are pleased to inform you that RRM Management agrees to your request and has accordingly granted you permission to conduct the above mentioned research, in a period of **Two (02) Months** effective **Thursday 1st October, 2020** at no cost implication to Ms. Roofings Rolling Mills Limited.

While conducting your research, you are expected to adhere to set Policies & Procedures in addition to handling all matters with utmost confidentiality. As a researcher you shall not disclose or publish any trade secrets or confidential information pertaining to the business of the company to any person or authority during performance of your research or thereafter. The company reserves the right to take appropriate legal action in the event of breach of this undertaking.

For Ms. Roofings Rolling Mills Limited,

ROOFINGS ROLLING MILLS LTD
P.O. BOX 35086, KAMPALA

SHEIKH ARIF
DIRECTOR – TECHNICAL

CC: HUMAN RESOURCE MANAGER
CC: RRM PLANT MANAGERS
CC: HOD, MECHANICAL & PRODUCTION ENGINEERING, KYAMBOGO UNIVERSITY

ROOFINGS ROLLING MILLS LTD.
(STEEL ROLLINGS)
Plot 406 Kampala Industrial Business Park • Namanve • P.O. Box 35086• Kampala
Uganda Telephone (+256)039-2-700952 • Telefax (+256)039-2-254952

1.8 Introductory Letter

KYAMBOGO UNIVERSITY

P.O. BOX 1 KYAMBOGO, KAMPALA-UGANDA
Tel: 0414 -285001 / 580320
E-mail: mechanical@kyu.ac.ug
www. Kyu.ac.ug

Department of Mechanical and Production Engineering

8th September 2020

The
Plant Manager
Roofing Group Ltd
Namanve Industrial Park

Thru
The Human Resource Manager
Roofing Group Ltd
Namanve

Dear Sir / Madam

RE: **GRADUATE STUDENT RESEARCH PROJECT**

I am obliged to write to you at this moment regarding the above referenced caption. The Department of Mechanical & Production Engineering of Kyambogo University runs a Master of Science Degree Programme in Advanced Manufacturing Systems Engineering. One of the requirements for an Award of the Degree is for the student to conduct an Industrial Project which has a contribution to knowledge and Industry / the Company.

Sir / Madam, the bearer of this note **(Mr. Bwengye Innocent)** is in the final year pursuing the MSc in AMSE here. His topic for Research is **Impact of Investment in Occupational Safety and Health on a Steel Manufacturing Plant in Uganda – Roofings Rolling Mills**. Thus, your organization was identified as suitable for his research. We therefore, kindly request you to assist him and grant him permission to do his research with you.

On behalf of the Department of Mechanical and Graduate School of Kyambogo University, I wish to inform you that this research is purely for academic purposes and the student is under strict rules to keep all information about your Company that he might come across confidential. In case you have any query, feel free to contact me the undersigned.

Thank you

Yours Sincerely

Dr. Titus Bitek Watmon
Head of Department
Mechanical and Production Engineering
Email: twatmon@kyu.ac.ug
+256 784 111 862

DEPARTMENT MECHANICAL AND PRODUCTION ENGINEERING
KYAMBOGO UNIVERSITY
08 SEP 2020
P.O. BOX 1 KYAMBOGO
HEAD OF

For approval
10/9/2020

Cc: Dean Graduate School, Dean of Faculty of Engineering, Mr. Bwengye Innocent, Project Coordinator, File