UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

STRATEGIES TO MITIGATE THE CAUSES OF CONSTRUCTION ACCIDENTS IN THE TAMALE METROPOLIS: PERSPECTIVES OF SITE MANAGERS

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A Dissertation in the Department of CONSTRUCTION AND WOOD TECHNOLOGY EDUCATION, Faculty of TECHNICAL EDUCATION, submitted to the School of Graduate Studies, University of Education, Winneba in partial fulfilment of the requirements for the award of Master of Technology (Construction Technology) degree.

AUGUST, 2016

DECLARATION

STUDENT'S DECLARATION

I, JOHN BOSCO KUBATI NYAMADOR declare that this Dissertation with the exception of quotations and references contained in published works which have all been identified and duly acknowledge, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE: …….....

DATE: ……

SUPERVISOR'S DECLARATION

I hereby declare that, the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of Dissertation as laid down by the University of Education, Winneba.

NAME OF SUPERVISOR: DR. Nongiba Alkanam Kheni

SUPERVISOR'S SIGNATURE: ……

DATE: ……

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DEDICATION

This Dissertation is dedicated to my wife Abane Aduko Christiana and my children Lucas Nyamador, Kenneth Selorm Kubati Nyamador, Frederica Edinam Nyamador and Kendra Senanu Kubati Nyamador. Also to my brother Daniel Kweku Nyamador and his Wife Joyce Kuti for their prayers and support.

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ABSTRACT

The Construction industry plays a major role in any economy and its activities are also vital to the achievement of the socio-economic development goals of providing shelter, infrastructure and employment. However, the construction industry is also recognized as an accident prone industry in Ghana. The ever-increasing cost of medical treatment, tends have a negative impact on a company's profit. The aim of the study was to examine strategies for mitigating the causes of work-related accidents on construction sites in Tamale Metropolis. The specific objectives of the study included; to identify the causes of work-related accidents on construction sites in Tamale Metropolis, to identify effective strategies for preventing or minimizing occurrence of accidents on construction sites in the Tamale Metropolis and to make recommendations for minimizing the occurrence of accidents on construction sites in the Tamale Metropolis. Using purposive sampling technique, survey questionnaires were administered to a sample of one hundred and twenty-eight (128) site managers and a response rate of 48% was achieved. The findings indicated that more than half of the respondents are of the view that workers negligence, equipment without safety devices, negative attitude of workers, improper supervision and management attitude are the major causes of accidents on construction sites. The findings also indicated that the effective strategies for mitigating the causes of construction site accidents included; knowledge on the rights on health issues as a workers, training on health and safety issues, first aid promptly administered, proper understanding of warning signs at the workplace and conducting periodic safety seminars and safety campaigns. Based on the findings, the study recommends that management of construction firms should be more committed towards ensuring safety on construction sites and safety campaigns, incentives and education need to be vigorously pursued by management.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The construction industry contributes significantly to national economic growth and offers substantial opportunities for job creation; it is one of the world's biggest industries that includes jobs as diverse as building, civil engineering, demolition, renovation, repair and maintenance. It accounts for a large proportion of GDP − for example, 17% in Japan and 10% in the U.K (Hallowell, 2011; Hinze and Teizer, 2011). However the industry has continually been plagued by workplace accidents. Hinze and Teizer (2011) further indicated that despite improvement in safety management, fatalities are still frequent. Construction workers are exposed to a wide variety of hazards on the job. Occupational Safety and Health Administration, (2005) ascertained that there are at least 60,000 fatal accidents on construction sites annually around the world, the fatal injury rate for the construction industry is higher than national average among industries worldwide. In China, there were an estimated 3,000 construction industry fatalities in 2003 alone (Fang, Huang and Hinze, 2004). In Korea, the construction industry was responsible for greatest number of fatalities among all industries (Yi, Kim, Kim and Koo, 2012). Data from a number of industrialized countries show that construction workers are 3 to 4 times more likely than other workers to die from accidents at work (ILO, 2009).

In developing countries, the risks associated with construction work may be 3 to 6 times greater than other industries. Danso (2005) reported in his studies that, in Ghana the construction industry, recorded 902 accident cases comprising 56 fatal accidents in 2000 and

846 non-fatal accidents. In that same report, Danso (2005) indicated that Kumasi (the regional capital of Ashanti Region) alone recorded 124 construction accident deaths from 1999 to 2004.

The reasons construction is risky and prone to accidents and health related risk are because of the physical environment of the work, nature of the construction work operations, construction methods, construction materials, heavy equipment used, and physical properties of the construction project itself (Menzel and Gutierrez, 2010). Some accidents are minor, such as getting a splinter in your finger. Other accidents are serious, causing severe property damage, personal injury or even death (Fales, 1990).

In spite of these challenges, the construction industry plays an important role in any economy and its activities are also vital to the achievement of the socio-economic development goals of providing shelter, infrastructure and employment (Anaman and Osei-Amponsah, 2007). Indeed, the interdependence of the construction sector and economic development has been addressed by various writers and in all cases, there is evidence indicating a direct link between investment in construction and economic growth.

For instance, in an extensive study by Lopes (1998), it was revealed that countries that invested minimum of 4% into construction industry are likely to grow faster in their Gross Domestic Product (GDP). In Ghana, just like many other developing countries the construction industry is playing a vital role to achieve socio-economic development goals, providing shelter, infrastructure and employment, and above all contributing significantly to the GDP of the country. For instance, since 2003 to 2008, the industry has consistently provided an average GDP growth of 6.1% to the economy. Indeed, the construction industry in Ghana was the third largest growing economic sector outstripping the manufacturing industry in 2004 with a constant GDP growth of about 5.8 % from 2004 to 2005. This remarkably consistent growth increased to 6.1 % in 2006. In 2007, it had picked

up again from 6.2% and peaked at 7.3% in 2008 (ISSER, 2005; IYF, 2009; IMF, 2009 and DI, 2009). This shows that the industry has a huge potential of leading the way for the economic development of developing countries such as Ghana if well exploited. Thus in specific terms, the Ghanaian construction industry could be the instrument for achieving the infrastructural guidelines of the Millennium Development Goals (MDGs) and The Ghana Poverty Reduction Strategy II (GPRS II) agenda. One of the main agenda of MDGs and GPRS II 2 is to address human development issues of which Cotton et al. (2005) noted that the agenda is achievable by the provision of infrastructure for services and employment through the construction industry if health and safety on construction sites are improved to promote and sustain efficiency.

Admittedly, though some studies have been done in Ghana relating to health and safety issues of workers in the construction industry, these studies did not focus directly on health and safety issues affecting construction workers in the Tamale Metropolis (capital of Northern Region). For example, Kheni (2008) in his studies did mention how construction workers in their quest to meet their basic needs, such as food and shelter, have compromised their demand of health and safety rights. It is worth noting that specifically, issues of health and safety affecting construction workers in Tamale (one of Ghana's fastest growing metropolis) were not discussed. Danso (2005) observed in his studies, at improving health and safety on building construction sites that about 65% of construction artisans, especially the new entrants, do not have knowledge on safety issues on construction sites. Again this deficiency of safety awareness is not clearly linked to construction workers in Tamale. Thus while these studies were making significant contribution towards understanding of health and safety issues in the Ghanaian

construction industry, these studies did not relate the issues of health and safety specifically to construction workers in the Tamale Metropolis, who now constitute a large number of the total workforce on most of the project sites and significantly contributing to the Ghanaian GDP. It is believed that if a study of this kind is undertaken, accidents on building construction sites will be reduced.

1.2 Statement of the Problem

According to Armstrong (2006), thousands of people are killed at work every year and several hundred thousands more are injured. It is also estimated that apart from the pain and misery caused to those directly or indirectly concerned, the total cost to employers of work related injury and illness exceed £4 billion a year. The complex nature of the construction industry in Tamale Metropolis makes it vulnerable to potentially dangerous conditions that affect the safety of all personnel working on construction projects in the industry. Construction is a relatively high accident prone industry. Based on the world's statistics, the accident rate in the construction industry is almost three times higher than that of the manufacturing sector (Sengupta and Guha, 1999).

A comprehensive data compiled by Amegbey (2009) unveiled a common myth that 85% of all accidents within and outside the construction sites are caused by factors of unsafe acts or behaviour of people or workers. Amegbey (2009) names these factors as immediate, basic and lack of compliance to safety regulations. With continuing high work related injury and illness rates in the construction industry, the identification of the causes and the strategies of preventing accidents in the construction industry and the implementation of safety practices, will help reverse such high rates. Such safety practices

that are successful in accomplishing low injury rates will lead to increased safety performance in the construction industry.

1.3 Aim and Objectives of the Study

The aim of the study is to examine strategies for mitigating the causes of work-related accidents on construction sites in Tamale Metropolis. The specific objectives of the study are as follows:

- To identify the causes of accidents on construction sites in Tamale Metropolis.
- To identify effective strategies for preventing or minimizing occurrence of accidents on construction sites in Tamale Metropolis.
- To make recommendations for minimizing the occurrence of accidents on construction sites in the Tamale Metropolis.

1.4 Research Questions

This study sought answers to the following research questions:

- What are the causes of accidents on construction sites in Tamale Metropolis?
- What effective strategies can be employed to prevent or minimize accidents on construction sites in Tamale Metropolis?
- What are the health and safety issues confronting construction workers in the industry and how can this be managed efficiently to enhance productivity?

1.5 Significance of the Study

Construction accidents have been causing many human tragedies, loss of life, Productivity, and delay projects. The main reason for this study was the need for preventing accidents in the construction sites in the Tamale Metropolis.

The outcome of the study will serve as a baseline information and extend the frontiers of knowledge about the strategies of preventing accidents in construction sites as well as provide information for policy formulation with respect to the construction industry in Ghana.

It will also serve as a reference point for other researchers who would want to research further into the strategies of preventing accidents in the construction industry. The research results, if properly disseminated will help building construction regulators to adequately supervise the activities of construction firms to ensure their strict adherence to health and safety regulations during construction work.

1.6 Scope of the Study

The research was restricted to the Tamale Metropolis. Really the intention of this study was to cover a wider scope in Ghana. However, due to especially the financial constraints, the study was restricted to Tamale. This should not minimize the importance of the findings because, Tamale is one of the fastest growing Metropolis in Ghana. As the capital of the Northern Region, it is an important commercial center (KPMG, 2008). Tamale's location, climate and safety, combined with Ghana's increasing access to foreign markets, make it a city among others to attract investment in a number of sub-sectors such as agro-processing, the hotel industry, the production of pharmaceuticals, real estate

development (KPMG, 2008). Investment in these sub sectors has called for the expansion of some existing facilities such as business centers, retail shops, warehousing, stores and the construction of new ones such as the expansion of the Tamale Teaching Hospital, upgrading of Tamale International Airport and the affordable housing project. There is also the construction of new road networks such as the rehabilitation of urban and feeder roads. Indeed there are a lot of construction works going on in the Tamale Metropolis which has made Tamale a gateway of attracting pools of workers from the neighbouring villages and towns to be hired for any type of skilled or unskilled construction works, and this should make the study relevant.

1.7 Limitations of the Study

The study was limited to only construction companies in the Tamale Metropolis. However, due to the nature of the programme it was not only difficult, but impossible to cover all construction companies in Ghana.

Moreover, some of the respondents were reluctant to cooperate with the researcher in responding to the questionnaires as they lamented that they have been wasting their valuable time by participating in numerous surveys without seeing any new thing that is done, as the results of those research findings did not improve their working conditions.

1.8 Organization of the Study

This study was organized into five main chapters. The first chapter included a background to the study, problem statement, aim of the study, research objectives of study, research questions, and significance of the study, research methodology, delimitations and organization of the study.

Chapter two discussed the relevant literature from the perspectives of scholars in this area of study. Chapter three constituted the methodology employed in the study. It also included the research design, population, sample and sampling method, data collection techniques, data analysis. The fourth chapter of this work also include analysis, presentations and interpretations of collected data. The final chapter (chapter five) discusses the findings, conclusions and recommendations made.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The chapter presents the overview of the Global and Ghanaian Construction Industry, its significance in terms of Gross Domestic Product (GDP) and employment. This is followed by the overview of construction accidents, its causes and types. The general theories of accident causation and theories of accident causation in construction are also discussed. The chapter also elaborates on issues relating to the strategies for preventing accidents at the design and construction stages. The chapter also discusses the regulations aimed at work-related accident prevention in Ghana, such as the labour Act, 2003 (Act 651), Factories, Offices and Shops Act, Workmens Compensation Act and the ILO Convention.

2.2 Overview of the Construction Industry

As the world population is expected to increase by another 2 billion between 2003 and 2015 (Van Wyk, 2003), infrastructure development in developing countries has become challenging. It is estimated that approximately 1.2 billion people globally lack access to safe water, 2.4 billion lack access to adequate sanitation, 2.5 billion people lack access to energy supply and 900 million people in rural areas have no reliable roads to give them access to jobs or markets for their products in sub-Saharan Africa, where less than 8.5% of the population is connected to power grid (Van Wyk, 2003). It is estimate by the world bank that investment in infrastructure needs to be doubled from about US$ 15 billion

to US$ 30 billion to reach the Millennium Development Goals (MDGs) aimed at reducing poverty by 2015 (Van Wyk, 2003).

According to Van Wyk (2003), construction constitutes more than half the total national capital investment in most countries and can amount to 10% of Gross Domestic Product (GDP). Employment in the sector is estimated at about 111 million workers worldwide and accounts for almost 28% of all industrial employment with 75% of construction workers found in developing countries. Micro construction firms, which normally employ less than 10 people account for 90% of construction workers, whereas small and medium enterprises (SMEs) constitute 97% of all construction firms globally. This sentiment is true of developed countries such as France and Germany, where there are fewer than 10 large national contracting firms who employ thousands of employees. Furthermore, Schmeimann, (2009) indicates that statistics of the European Union show that 99.8% of all registered enterprises in the non-financial sector were regarded as SMEs, employing two thirds of the total work force in Europe and generating approximately two-thirds of all value added.

Van Wyk, (2003) further indicated that the construction industry is viewed as an economic multiplier. One job in construction gives rise to two other jobs in construction and elsewhere in the economy. On this basis, as much as 20% of all employment can be ascribed to construction activities. Furthermore, the nature of construction activities differs between developed and developing countries. In developed countries building work is oriented towards renovation and maintenance, whereas in developing countries it is oriented towards new construction.

These economic developments are an avenue to ensure an appropriate health and safety (H&S) culture that would reduce the poor performance of H&S on construction sites in developing countries such as Ghana.

2.2.1 The Ghanaian Construction Industry

The construction industry, according to Anaman and Osei-Amponsah, (2007) adopted from Lange and Mills (1979), is defined as a group of firms with closely related activities involved in the construction of real estates, building, private and public infrastructure. It also deals with all economic activities directed to the creation, renovation, repairs or extension of fixed assets in the form of buildings, land improvements of an engineering nature and other such engineering constructions such as roads, bridges, railways, ports, dams. In Ghana, Civil Engineering firms undertake some of the aforementioned projects which involves heavily engineering characteristics such as bridges, roads, railways and dams, while the Building Construction Firms (BCF) also undertake projects such as the construction of schools, hospitals, health centers, hotels, offices. BCF also undertakes external works which sometimes involved "simple" engineering construction such as drive ways.

The Ghanaian building construction firms comprises of a large number of enterprises of various sizes as registered and categorized by the Ministry of Water Resources, Works and Housing (MWRW&H) as D1K1, D2K2, D3K3 and D4K4. Based on factors such as annual turnover, equipment holding, personnel, the D1K1 class of contractors are termed as larger firms, whereas D2K2 construction firms are medium and D3K3 and D4K4 are small firms (Edmonds and Miles, 1984). The larger firms, according

to MWRW&H are registered as financial class 1, capable of undertaking projects of any value, class 2 (the medium firms) are capable of undertaking projects up to US$500,000 or GH¢750,000.00, while the small firms (financial class 3) are also capable of undertaking projects up to US$200,000 or GH¢ 300,000.00 or class 4 to undertake projects up to US$75,000 or GH¢112,500.00.

Egmond and Erkelens, (2007) reported that, the large and medium Ghanaian construction firms forms about 10% of the total number of construction firms registered with the Ministry of Water Resources, Works and Housing. These firms, according to Egmond and Erkelens, (2007) do not have the appropriate technological capabilities, plant and equipment and key personnel to handle awarded projects properly and the evidence is by the fact that the nation's major construction projects are awarded to the very few large foreign contractors. The remaining 90% are the small firms or small contractors of which in 1999, their total number was 7095. As indicated earlier on these small firms engage in simple construction work with contract sum not exceeding US$ 200,000 or GH¢300,000.00 in public jobs, and their total construction output ranges between 10% and 20% as compared to large and medium firms. Egmond and Erkelens, (2007) suggest, that the proprietors of these small firms have little or no knowledge in the building construction industry and their perception about industry is a money making business and the only requirement is your financial ability. From this perception, it is possible that management of these small firms do not really pay attention to labour resource management which is one of the key factor for performance and growth of a firm (Mitullah and Wachira, 2003).

2.2.2 The Significance of the Ghanaian Construction Industry

The construction industry plays an important role in any economy and its activities are also vital to the achievement of the socio-economic development goals of providing shelter, infrastructure and employment (Anaman and Osei-Amponsah, 2007). Indeed, the interdependence between the construction sector and the economic development has been addressed by various writers and in all cases, there is evidence indicating a direct link between investment in construction and economic growth. For instance in an extensive study by Lopes (1998), it was revealed that countries that invest at least a minimum of 4% in construction industry are likely to grow faster in their Gross Domestic Product (GDP).

In Ghana, just like many other developing countries the industry is playing a vital role in socio-economic development goals, providing shelter, infrastructure and employment and above all contributing significantly to the GDP of the country. For instance, since 2003 to 2008, the industry has consistently provided an average GDP growth of 6.1% to economy. Table 2.1 and Figure 2.1 below indicate the contributions of the construction industry to the Ghana's GDP.

Table 2.1: Construction Industry Contribution to Gross Domestic Product (GDP)

Year	Sector growth rate %	GDP %
2003	6.1	5.2
2004	6.6	5.8
2005	7.0	5.8
2006	8.2	6.2
2007	10.3	6.3
2008	11.0	7.3

Source: ISSER 2005, IYF 2009, IMF 2009, DI 2009

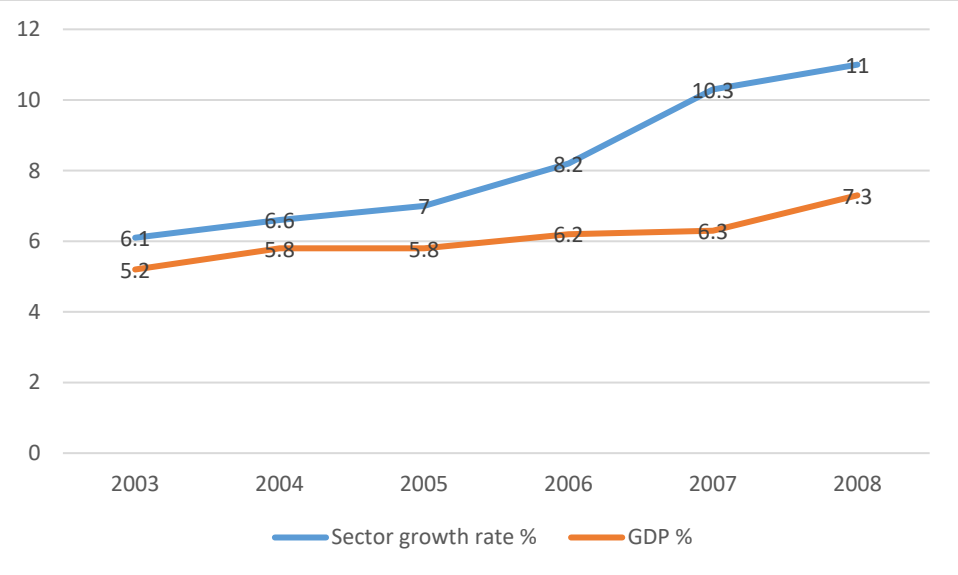

Figure 2.1: Construction Industry Contribution to GDP

Source: ISSER 2005, IYF 2009, IMF 2009, DI 2009

From the graph (Fig. 2.1), the construction industry in Ghana, as at 2003 had a GDP growth of 5.8% and experienced a constant GDP growth of about 5.8 % from 2004 to 2005. This remarkable consistent growth increased to 6.2 % in 2006. In 2007, it had picked up again from 6.2 % and peaked at 7.3% in 2008. Further, Anaman and Osei-Amponsah, (2007), did an extensive study by monitoring the subsector growth of construction industry with other sectors. Anaman and Osei-Amponsah, (2007), concluded that the construction sector is the third fastest growing economic sector based on value added to GDP and that the construction industry outstripped the manufacturing industry in 2004.

Besides these important GDP contributions, the construction industry in Ghana has a huge potential of contributing to employment creation. For example, Aryeetey, (2004) noted that within the active working population of 15-64 year-olds in the formal sector, construction employment increased from about 22,400 in 1980 to about 23,200 in 1985. Further evidence from the Ghana Living Standards Survey (GLSS) indicate that the

construction sector in 1991/1992 accounted for 1.2% of active working population of 602,000, and in 1998/1999 it accounted for 1.4% with the active working population of 102,000. Table 2.2 together with its graph in figure 2.2 below shows the growing trend of construction employment over a given period of about 17years.

Table 2.2: Growth of Construction Employment in Ghana

	Urban in (%)			Rural in (%)			Ghana in (%)		
Year	**Male**	**Female**	**All**	**Male**	**Females**	**All**	**Males**	**Females**	**All**
1991/92									**1.2**
1995							2.5	0.1	**1.2**
1997									**2.0**
1998/99							2.8	0.2	**1.4**
2000									**2.5**
2003									**3.9**
2005/06	6.8	0.2	3.5	1.8	0.0	0.9	3.5	0.1	**1.8**
2007/08									**2.3**

Source: (GSS, 1995), (GSS, 1998), (GSS, 2000A), (GSS, 2002), (GSS, 2003), (GSS, 2008)

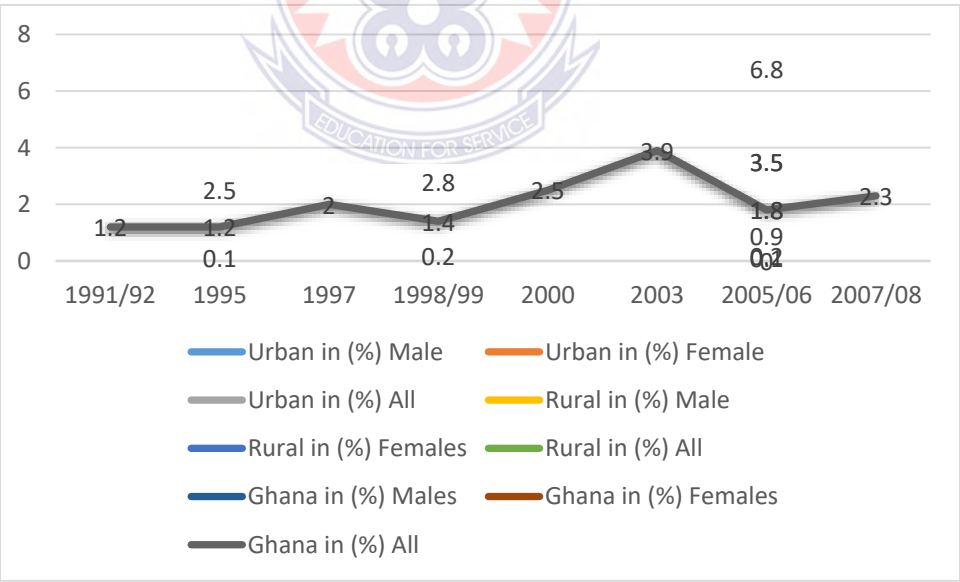

Figure 2.2: Trends of Construction Employment

Source: (GSS, 1995), (GSS, 1998), (GSS, 2000A), (GSS, 2002), (GSS, 2003), (GSS, 2008)

2.3 Construction Accidents

The construction work site is usually a busy place with many activities on going. The accident rates closely correlate to the level of activity within the industry, indicating that when work load is high, safety tends to receive less attention. The dangers faced by construction workers are alarming. The rate of death of workers is higher in construction industry than any other industry (ILO, 2009). Moreover, construction industry presents a high rate of death by injury. Although construction represents only 6% of US workers, it produces 20% of the fatalities (El Safty et al., 2012). Job accidents impose on the construction industry a tremendous burden of needless and avoidable expense.

2.3.1 Concept of Accident

Accident can be described as an unpleasant and unexpected event that causes injury, damages and could result to death. Mwombeki (2005) views accident as an unplanned and unexpected occurrence, which upsets a planned sequence of work; resulting to loss of production, injury to personnel, damage to plant and equipment and eventually interrupting production flow. Every year, many people fall victim of injury, harm and even death through accidents on building site because these sites are rife with dangers. The construction industry has one of the worst injury experiences record among the industries, and these records have been maintained for a long period of time (I.L.O, 2005). It was further ascertained that there are at least 60,000 fatal accidents on construction sites annually around the world. This rate is very high and frequent occurrence of accident on sites has led to loss of lives, properties, workers, money, materials and time. The fatal

injury rate for the construction industry is higher than national average among industries (O.S.H.A, 2005).

2.3.2 Definitions of Related Terms

The field of risk management is faced with difficulties in defining and agreeing on principles. Risks are dealt with differently across different countries, industries and sectors and fields. Terms, definitions and interpretations are as varied as the number of sources providing them. There are no agreed unified definitions of risk, risk analysis, assessment and management. There are often misconceptions. Different terms, for example “risk analysis” and “risk assessment”, are often used interchangeably (Lingard and Rowlinson, 2005).

2.3.2.1 Health

Health is the general condition of a person in mind, body and spirit, usually meaning to be free from illness, injury or pain. The World Health Organization (WHO) defined health in its broader sense in 1946 as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (WHO, 2006). In this study health means being free from illness, injury or pain which can be caused by construction activities.

2.3.2.2 Safety

Safety refer to the control of recognized hazards in order to achieve an acceptable level of risk (.https://en.wikipedia.org/wiki/Safety)

According to the business Dictionary, safety is defined as a relative freedom from danger, risk, or threat of harm, injury, or loss of personnel and/or property, whether caused deliberately or by accident. Safety can also be defined as the control of recognized hazards to achieve an acceptable level of risk. In this study, safety means freedom from danger, harm, and injury to the person involved in construction activities.

2.3.2.3 Hazards

A hazard is the potential for harm. In practical terms, a hazard is often associated with a condition or activity that, if left uncontrolled, can result in an injury or illness. HSE (2004) define hazard as any source of potential damage, harm or adverse health effects on something or someone under certain conditions at work. Basically, a hazard can cause harm or adverse effects (to individuals as health effects or to organizations as loss of property or equipment). In this study hazard mean anything which has the potential to cause harm to people on construction sites.

2.3.2.4 Risk

Risk has been traditionally defined as a measure of the probability and severity of adverse effects (Haimes, 2009). Rowel (1982) provides that risk is related to hazard whereby risk becomes the hazard level (hazard severity) combined with the likelihood of

the hazard leading to hazard consequence. Valsamakis et al. (2004) define risk as a variation in actual outcome from the expected one, which implies the presence of uncertainty. The general concept of all definitions of risk provides that risk is a danger of unwanted and unfortunate events. For the purpose of this study risk is a probability of occurrence (likelihood) of an event and the magnitude of its consequence (Kaplan and Garrick, 1981; Mondarres et al., 1999).

2.3.3 Categories of Construction Accidents

Kripendirff (2004), found the following to be causes of accidents and the common types of accidents on Construction Sites:

2.3.3.1 Casualty error:

This category includes all the actions, behaviors, omissions or misjudgments of the person who was injured in the accident. Examples in this category include: accepted poor kit, alpha sleep, carelessness, poor planning, human error, ignorance of wear limits, low self-respect, poor grip, poor observation and unsafe manual handling. Casualty error led to the following accidents slips on rough and wet grounds.

2.3.3.2 Work method:

This category includes the procedures and/or techniques employed to execute the activities. Examples in this category include: mini-crane not properly fitted; poor practice – failure to use lifter; poor practice - manual handling; unsafe loading practice; unsecured

shoring; and used tow-bar as a step. This led to the following accidents, cut hands whiles lifting, burn to wrist by electric flush from lose lead.

2.3.3.3 Poor quality kit:

This category includes all situations in which defective and/or poorly maintained tools and/or equipment contributed to the accident. Examples in this category include: degraded cable; grinding disc in poor condition; fault with pump starter; grinder not maintained; and poor maintenance. This led to the following accidents, dust into eye and back strain when lifting.

2.3.3.4 Poor health:

This category includes existing health conditions that contributed to the accident. In this category, there was only one case of arthritis that led to a back injury.

2.3.3.5 Site set up:

In this category, all issues relating to how the site was set out and organized are included. There were two cases in which traffic cones were not placed in the right places and injuries occurred as a consequence.

2.3.3.6 Site conditions:

This category includes the physical attributes of the site such as slope, dust and mud as well as the weather conditions such as wind and rain. The category also includes features of the site such as unprotected/unsecured temporary structures. Site conditions led to the accidents described thus:

- Fall through scaffolding ladder access gap and broke collar bone;
- Roping sprayer on back of truck - pulled rope, slipped and twisted knee;
- Walking over bank, slipped and pulled knee ligaments; and
- While lifting a manhole cover, foreign object got in eye.

2.3.3.7 Plant operator error:

This category includes actions, behaviors, omissions or misjudgments of the plant operator. Examples in this category include low safety consciousness, poor judgment and unguarded machinery. Plant operator error led to the accidents described here:

- 4-inch cut from sanding disc to leg;
- Hit by dumper bruising legs;
- Operative was run over by 3.5 ton dumper, sustained serious injuries;
- Roller rolled back off low loader and broke ankle;
- Runway paving machine hit vehicle and vehicle injured foot;
- Slipped off tow-bar and broke bone while hitching up trailer; and
- Struck from behind by waste moving machine, resulting in severe bruising.

2.3.3.8 Plant failure:

This category includes any type of malfunctioning of any piece of equipment/tool or any part of it. Examples in this category include structural failure and component jam. Plant failure led to the accidents described here:

- Got thermoplastic from lorry - splashed onto, and injured, arm;
- High pressure hose burst, abdomen punctured; and
- Mobile tower section fell while loading resulting in broken rib.

2.3.3.9 Packing error:

This category includes mistakes made in packing and loading materials and / components before they are brought to the site. Examples in this category include load not stacked properly and components not secured well. Packing error led to accidents described here:

- Bag of cold tar fell and injured leg; and
- Injured while unlocking steel casings with crane from lorry.

2.4 Theories of accident causation

Accidents can be defined as unplanned occurrences which result in injuries, fatalities, loss of production or damage to property and assets. Preventing accidents is extremely difficult in the absence of an understanding of the causes of accidents. Many attempts have been made to develop a prediction theory of accident causation, but so far none has been universally accepted. Researchers from different fields of science and

engineering have been trying to develop a theory of accident causation which will help to identify, isolate and ultimately remove the factors that contribute to or cause accidents.

2.4.1 General Theories of Accident Causation

There are several major theories concerning accident causation, each of which has some explanatory and predictive value.

2.4.1.1 Energy Release Theory

Haddon suggested that accident happens when there is an excess energy transfer (Lin and Mills, 2001). Accident causing agents such as electrical, mechanical and thermal, energy can lead to accidents. This model suggests that the occurrence of an accident basically follows the laws in physics: it happens after there is an excess amount of uncontrolled energy and consequences depend on the amount of energy (Briere et al. 2010).

Yet this model has received some complaints from Lingard and Rowlinson (2005) who pinpoint that the abstract nature of this model fails to lay down a good foundation in identifying hazards in routine work. It also fails to suggest the appropriate safety measures under different circumstances (Briere et al., 2010).

2.4.1.2 Heinrich's Domino Theory

In 1974 suggested that an accident can be viewed as the last domino in the 'domino sequence' where an accident is the result of a sequence of events. The first domino falls on the second one and the second one's fall leads to the fall of the third domino, so on and so

forth. Bird suggested that workers will be safe so long as the first domino, i.e., site management does not fall (Briere et al., 2010).

However, other researchers point out that there are many factors which lead to accidents. It is inappropriate to regard accidents as the last event in a sequence (Li, 2006). It can be the case like the last straw being placed on the camel. Pheng and Shiua (2000)'s contention was that these unsafe conditions were symptoms of management oversight and mismanagement in planning, organizing, commanding, coordinating and control. Nevertheless, such model has failed to make a clear relationship between various relations among personal and organizational factors. Readers of domino sequence may misunderstand that personal factors and mental stress play the same role in accidents. Hence, such theory often leads to a false interpretation on the underlying accident causation factors. This is particularly true for those high rank officers who usually do not have to work on site and lack safety knowledge in depth (Briere et al., 2010).

2.4.1.3 Heinrich's Axioms

Heinrich (1980) proposed that more than one-fifth of the accidents are caused by a series of unsafe acts which finally lead to accidents occurring. He further elaborates that the degree of injury is a matter of probability. Nevertheless, Cooke and Lingard (2011) suggest that Heinrich's model focuses too much on the immediate circumstances surrounding the incidents, it fails to include unsafe conditions which also have systemic and organizational causes. Furthermore, it is misguided to attribute incidents to interaction of multiple causes.

2.4.1.4 Potential Accident Subject Theory (1987)

Leather (1987) proposes that both endogenic and exogenic factors might affect the potential accident subject's acts and thoughts which might lead to accidents in Potential Accident Subject (PAS) model. The PAS stresses the dynamic relationship between various stakeholders on accidents, e.g., workers, managers within the construction companies or even those people who work outside the construction companies.

Under PAS model, any person even the victim himself can be the ''Potential Accident Subject''. Furthermore, people's behaviors and attitudes are affected by reward, management systems, punishment, training, and instructions given by seniors and so on. Some rewards for finishing tasks quickly may induce workers to take short cuts and ignore the possible sources of risks (Li, 2006)

2.4.1.5 Rasmussen's Work Behavior Theory (1994)

Rasmussen suggested that construction laborers' work is shaped by economic, functional, safety related objectives and constraints. The model identifies three zones: safe zone, (where the workers' behaviors comply with safety rules) hazard zone and loss of control zone. Most of the construction managers on site work along the cost gradient and the worker searches for the least effort gradient. All these end up with a systematic migration toward the boundary of acceptable performance only. In view of this, safety plans on site are often designed to act against the pressures outlined in the model. Nevertheless, the pressures that push workers toward the safe zone require a continuous effort. Rasmussen therefore proposes that accident prevention should focus on error

tolerant work systems development which makes the boundary of loss of control reversible and visible (Eun and Resnick, 2009).

2.4.1.6 Human Information Processing theory (2000)

Kjellen (2010) sheds light on human and environment interaction from an operator's point of view. Under this model, people are viewed as an information processor who makes their own judgment in response to environment risks, hazards or deviations. Accidents happen when people are unable to handle information under complicated circumstances. Accident analysis is a very good practice to identify and evaluate the safety risks on site and provide suitable safety measures in turn.

Yet, this model suffers from two very major drawbacks. Firstly, the model only sheds light on 'cold' variables with regard to human cognitive processes which does not conform well to real life situations. In reality, emotional variables such as threat do affect people's capability in problem solving and accident prevention.

Secondly, internal information processes are absent. Interpretation by actual behavior observations and interviews becomes necessary but this requires expertise. Because of the two aforementioned problems, application of this model is limited to in-depth investigation with experts' participation (Li, 2006).

2.4.1.7 Epidemiological Theory (2003)

Conventional safety theorists put the lens on finding out accidents and injuries. There is, however, a trend in encompassing environmental factors which may possibly

cause an accident. Based on this idea, the Epidemiological Model views accidents as a disease entity which arise as a product of interaction between the agent, environment and the host (Goetsch 2003).

2.4.2 Theories of Accident Causation in Construction

There are a number of accident causation theories, which Hinze, (1998) refers to, that relate to construction sites which are typically regarded as dangerous and hazardous. These include, *inter alia*:

2.4.2.1 Systems Theory of Construction Accident Causation (2005)

Building on Rasmussen's model and various construction accident causation models in the past, this model identifies various variables which influence the probability of accidents during a construction activity. While the arrows in the figure indicate cause-effect relationships, the signs show the directions of the relationship between different factors. A positive sign indicates that when there are changes in factor X, Y changes in the same direction. A negative sign signifies the effect of changes in an opposite way. This model proposes that unpredictable tasks and environments increase the likelihood of accidents as it increases the likelihood of errors hazardous situations and production pressures (Eun and Resnick, 2009)

2.4.2.2 Accident Proneness Theory

There are two views, namely an old and new view.

Old view: Injuries happen to people who have a genetic predisposition to being injured.

This suggests that certain individuals have inherent characteristics that predispose them to a greater probability of being involved in accidents.

New view: Accident proneness is being increasingly viewed as being associated with the propensity of individuals to take risks or to take chances. This view is more positive for health and safety, given that behaviour can be altered.

This theory focuses on personal factors related to accident causation and is based on the assumption that when many persons are placed in similar working conditions some would be more likely than others to sustain an injury suggesting that accidents are not randomly distributed.

2.4.2.3 Goals-Freedom-Alertness Theory

This theory suggests that accidents are the result of unsafe behavior resulting from an unrewarding psychological climate that does not contribute to mental alertness. Accidents are therefore attributed to low-quality work behaviour occurring in an unrewarding psychological environment.

2.4.2.4 Adjustment Stress Theory

Any complications or negative stresses imposed on an individual either by the internal environment (e.g. fatigue; lack of sleep; or psychological stresses such as worry, personal problems) or by the external environment (e.g. noise; temperature; excessive

physical strain) will increase accident occurrence. If the worker cannot adjust to the stress, the chance of injury is increased.

2.4.2.5 Chain of events (Domino theory)

This theory is not truly a theory of accident causation, but is often referred to as one. It is based on accidents being characterized as occurrences that result from a series of events which are all linked in that each event is followed by yet another event. It is really a conceptual portrayal of how accidents occur. The chain of events states that there is not a single cause of an accident but rather many causes.

In general, every accident is preceded by a series of events or activities. If any one event or activity had been done differently, the accident would not have occurred ("break the chain to avoid the accident"). Different people may be associated with the different links in the chain. There are many links in the chain and only one link needs to be broken to prevent an accident.

2.4.2.6 Distractions Theory

The Distractions Theory suggests that health and safety is situational, namely that workers perform tasks in an environment that is known to be hazardous. This theory states that accidents are caused when workers are distracted when they are performing their work tasks. There are two types of distractions:

Jobsite Hazards

Workers will try to avoid being injured. They will naturally focus on the hazard. Pressure to get the task done may cause the worker to be distracted and to ignore the hazard, resulting in an injury

Mental worries

Workers will try to focus on the work to be done, but may be distracted by worries caused by personal or job-related concerns. Failure to be able to focus on the work increases the likelihood of being injured.

More modern accident theories have shifted the emphasis from errors on the part of the individual to the management and organizational errors that cause poor health and safety performance. There are two of these theories (HSE, 2002), namely:

2.4.2.7 Reason's Framework for Accident Causation

Professor James Reason at the University of Manchester developed a theory of accident causation that spans the entire accident sequence from organizational to individual levels.

The theory follows modern trends in seeking causal factors that are removed in both time and space from the onset of the incident. Previously, accident investigations tended to highlight the role of the frontline operator as the most obvious and immediate instigator of the accident. Accidents in the construction industry are particularly prone to such interpretations – incidents regularly occur to individuals acting alone. Reason's theory

incorporates an organizational level analysis that takes into account the input of management and decision-makers.

2.4.2.8 Constraint-Response Theory

Suraji, Duff and Peckitt (2001) of University of Manchester Institute of Science and Technology (UMIST) and the Health and Safety Executive in the UK, developed a causal model specific to construction accidents. They cite Reason's model as a theoretical description but note the lack of specific detail necessary to guide practical investigation and intervention – "the effective mitigation of causal factors requires better knowledge of which factors are most influential, who may reasonably be expected to control those factors and how such control may most effectively be achieved" (Suraji, Duff and Peckitt, 2001).

Similar to Reason's model, the Constraint-Response Model extends the scope of the accident causation process to include management and organizational aspects. The model classifies two types of factors – distal and proximal, equivalent to latent and active failures in Reason's configuration.

2.5. Strategies for Preventing Accidents in Construction

The construction industry is notorious for having one of the worst safety records among all industries in the private sector (Bentil, 1990; and Behm, 2005). In the United States, the industry accounts for up to 18% of work-related deaths and 15% of all worker compensation cases with approximately 1,000 construction workers killed annually (BLS, 2000-2009).

Towards minimizing safety hazards and incidents, construction companies employ several strategies including safety planning, staffing and training among many others (CII, 2003). Different strategies apply to different project phases.

2.5.1 Strategies at the Design Phase for Accident Prevention

There is compelling evidence to suggest the decisions made by designers at the design stage of a facility can have significant implications on the safety of workers on site. Gibb, Haslam, Hide, Gyi and Duff, (2006) conducted a detailed review of 100 construction accidents in the UK and reported that in 47 percent of cases, a design change would have at least reduced the risk of injury. Behm (2006) analyzed 450 reports of construction workers' deaths and disabling injuries in the US and reported that in one third of the cases, the risk that contributed to the incident could have been eliminated if design-for-safety measures have been implemented. In Australia, Creaser (2008) confirmed that 37% of workplace fatalities in construction had design related issues involved, and design issues appeared to contribute to at least 30% of injuries. Hence, it can be argued that one of the most effective means of dealing with hazards is to eliminate them at the source, that is, Prevention through Design (PtD).

2.5.1.1 Accident Prevention through Design (PtD)

The role of designer has traditionally been to design a facility such that it conforms to the accepted local building codes. The safety of construction workers is left up to the contractor.

However, research shows that designers can have a strong influence on construction safety. The ideal time to influence construction safety is during the inception, concept design and detailed design phases. In these phases, designers can influence construction safety by making better choices in the design stage of a project. This would result in fewer site decisions that have to be made by contractors. Hence, the notion of prevention through design (also known as safe design or designing for safety) transpires from this principle. By definition, prevention through design is a methodology applied to the various phases of the design process for identifying and mitigating risks and hazards that will be encountered by construction workers during the construction of the facility on site. This involves systematically identifying hazards and risks and introducing mitigating design solutions that will meet the design requirements as well as create a safe work environment for the workers. It also encompasses communicating to the contractor the remaining hazards and risks that could not be eliminated during design so that the contractor may plan for appropriate engineering controls to reduce their impacts (Furst, 2009).

The key feature of PtD process is the input of site safety knowledge into design decisions. The type of knowledge that is critical to a successful PtD implementation in design organizations include.

- Construction methods of design elements and the risks faced by workers on site in the process of building the elements.
- Safe design suggestions for making design changes or incorporating safety devices in the design.
- On-site safety measures to eliminate or reduce the risks for hazards that could not be eliminated at the design stage.

2.5.1.2 Building Information Modelling (BIM)

BIM is an emerging paradigm in the design and engineering fields that enables the creation of digital 3D models of buildings with embedded information about a project from design through to construction and into operation. It integrates information from disparate disciplines, combining these with a spatial 3D CAD platform to generate a digital representation of the physical and functional characteristics of a building design. It is more than just a 3D virtual model, but rather a repository of intelligent building objects with attributes and relationships, making it an effective vehicle for automated design decision-making.

BIM has been utilized extensively to simulate performance and optimize designs in view of feasibility studies and stakeholder concerns, value analysis, constructability analysis, sustainability analysis, site layout for operational efficiency and facilities management (Whyte, 2002; Augebroe and Hensen, 2004; Onuma and Davis, 2006; Bendixen and Koch, 2007; Hartmann, Gao and Fischer, 2007; Azhar, Brown and Farooqui, 2008). All these studies confirm that the utilization of BIM technology can enhance the quality and efficiency of the various analyses and, as a result, the optimization of the design to yield the best outcome at the design stage of a project.

2.5.2 Construction phase accident prevention strategies

Over the past decades, concern for construction accidents has intensified due to the increasing costs of workers' compensation insurance, the increasing number of liability lawsuits and the intensification of safety regulations (Gambatese et al., 1997). Largely as a result, the construction industry has been experiencing a steady decline in the incident

rates of fatalities and disabling injuries (Gambatese et al., 1997; and BLS, 2000-2009). This decline, though encouraging, has however not been significant enough to diminish the industry's prominence in poor safety. Construction companies employ several strategies including safety planning, staffing and training among many others towards minimizing accidents during the construction stage (CII, 2003).

2.5.2.1 Hard Technology

Hard technology involve the physical activities that are carried out to prevent accidents at the construction site. Some of these activities include;

- Safe working Procedure. By making sure all people working at heights are equipped and knowledgeable about their safety harness and the correct way of wearing their protective gear. The safety officers have to ensure that all participants are guarded against the ever present dangers on construction sites
- Personal Protective Equipment and Clothing. Personal protective clothing or PPE would refer to protective clothing, or other gear designed to protect the wearer's body or clothing from injury by electrical hazards, heat, chemicals, and infection, for job-related occupational safety and health purposes (Hughes & Ferrett, 2008). PPE is to be used as a control measure. It will not eliminate the hazard and will present the wearer with the maximum health risk if the equipment fails. Successful use of PPE relies on good user training, the availability of the correct equipment at all times, and good supervision and enforcement.

  There are several types of personal protective equipment, such as:

  - safety boots

- hearing protection
- eye protection
- hard hats
- hand protection
- protective clothing
- safety harnesses or belts

When selecting PPE, several factors need to be considered. These include the nature of the hazard (the severity of the hazard and its associated risk will determine the quality of protection required), comfort and user acceptability, compatibility with other PPE, training and maintenance requirements and costs (Hughes & Ferrett, 2008).

It is important to note that the appropriate PPE should also be made available to visitors and other members of the public when visiting construction sites. The use of PPE cannot be stressed enough and it is vitally important that site agents and managers lead by example in its use and enforce it even if it means taking disciplinary action against the defaulting individual

- Risk Assessments for activity – Site specific. Risk assessments should ideally be performed stringently before the start of the project and constantly during the project. Reason being is that a number of tragic events could occur at any time with the heavy duty power tools being used by labourers daily. The risk assessment is there not only to protect the workforce but the contractor as well because in the event that something were to happen, the contractor would not be held liable because the contractor, being a reasonable man, had checked for possible threats of danger.

2.5.2.2 Soft Technology

These are activities on site which accommodates human-oriented ways of doing things and are connected to the safety of workers on site but are not physical. Examples of soft technology on includes;

- Health and Safety Training. This is a very important aspect of the H&S programme and it is also a legal requirement according to the H&S Act for employers to provide such training to all their employees. Training is required for employees at various levels during different stages of their careers or the project life cycle depending on the nature of the job that individuals will be undertaking.

  Additional training may be required following a single or series of near misses, the introduction of new legislation, the issuing of an enforcement notice or as a result of a risk assessment or safety audit (Hughes &Ferrett, 2008). There are several different types of training, these include induction training, job specific training, supervisory and management training and specialist training. Risk assessment, fall protection plan training and supervision training are all legal requirements and fall within the scope of the aforementioned types of training.
- Method statement. The method statement of a company is a declaration of all companies' beliefs and values. The value of its employees should be of the utmost importance. Therefore it has to be frequently visited to ensure that it is maintained and supported throughout the project.
- Toolbox talks. It has been noted that many sites undergo a weekly ritual of gathering a congregation of labour and explaining to them the hazards of their environment. And while one may contest that this procedure is monotonous, some of the labour need to

be constantly reminded so that they know how their actions impact the people around them. These toolbox talks, in order to be effective, should be held at least once every week.

- Encouraging Workers Participation in safety Management. It has been found that word of mouth communication is more effective than rote learning. Therefore management should try to make their safety talks and instructions as interesting enough without being condescending, so that it can encourage workers to help out their fellow man. They should make training sessions freely available to willing participants so that it can be practiced throughout their career.

2.6 Cost of Accidents

The most common costs affecting the overall project include (Smallwood, 1995):

- Compensation insurance for employees
- Damage to materials, plant and equipment
- Damage to environment.

Hinze (1998) cited in Smallwood &Haupt (2006) further categorises the cost of construction into direct and indirect costs.

Direct costs are those associated with the treatment of injured parties as well as the compensation insurances provided for the employees in the event of an accident.

The indirect costs incurred by contractors include:

- Reduced productivity of injured party
- Reduced productivity of workforce
- Cost of delays

- Costs for provision of supervision
- Costs resulting from rescheduling
- Costs of transportation o Cost of replacing injured party
- Wages paid while the injured party is non-productive and recuperating

Davies & Tomasin (1996) cited in Smallwood & Haupt (2006) concur that accidents can marginalize the project team's efforts at achieving the project deliverables on time and within budget due to these costs associated with accidents. Furthermore, bad publicity arising out of these accidents may also tarnish the client's name and strain relations among project stakeholders as everyone is quick to blame the other.

In a study of the influence of H&S culture on H&S performance by Smallwood (2002), it was found that the following were manifestations of the negative impact of H&S performance:

- Poor house keeping
- Decline in productivity
- Programme delay
- Increased cost of accidents
- Increased accidents
- Increased compensation insurance claims
- Compensation insurance loading
- Harm to the environment
- Rework
- Non-achievement of quality
- Complications.

From the abovementioned manifestations, poor housekeeping (50%) and decline in productivity (50%) ranked the highest with programme delays (40%) and increased costs of accidents (40%) following close by. The fact that two manifestations were not H&S related ranked so high shows the significant impact that H&S has on other project parameters. Furthermore, increased costs of accidents (40%) achieved a higher ranking than increased accidents (30%).

2.6.1 Benefits of Reduced Cost of Accidents

In order to achieve proper H&S management, H&S performance needs to be continuously monitored and measured by recording the accident cost per work-hour. Management should use the feedback gathered from these records to reward employees for good H&S performance on site.

Reducing occupational accidents would not only save people's lives, but it would benefit contractors with reductions in workers' compensation (WC) and liability insurance premiums, WC rebates, as well as reductions in the indirect costs of accidents (Levitt & Samelson (1993) cited in Smallwood (2002)). Other benefits include enhanced morale of supervisors and workers, and increased attractiveness to clients as a result of perceived holistic quality. Geminiani & Smallwood (2008) further comment that the pressure placed on the country's monetary situation will be reduced as the excessive amounts of money paid annually to victims of work related accidents decreases.

Levitt & Samelson, (1993) cited in Smallwood (2002) maintain that most contractors do not have a cost accounting system that tracks the cost of accidents, which effectively marginalizes the undertaking of any cost-benefits analysis relative to H&S. The

ability to prove the benefits of H&S is important, as being able to do so reinforces the assumption that 'increased H&S effort will result in a decrease in incidents'.

2.7 Regulations aimed at Accident Prevention in Ghana

There are no health and safety regulations developed specifically for the construction industry. Considering the high risk nature of the sector, this limitation seriously handicaps the implementation of health and safety standards on construction sites. The Workmen's Compensation Law, the relevant sections of the Labour Act 2003 and Factories, Offices, are discussed in the sections that follow.

2.7.1 Labour Act

Part XV of the Labour Act, 2003 (Act 651) concerns the health and safety and environment of workplaces. Under this Act, it is every employer's duty to ensure employees work under satisfactory, healthy and safe conditions. Other sections of the Labour Act which impact on health and safety include: protection of employment relationship; general conditions of employment; protection of remuneration; unions; employers' organizations and collective bargaining agreements; National Tripartite Committee; and, labour inspection.

2.7.2 Factories, Offices and Shops Act

The Factories, Offices, and Shops Act 1970 caters for factories, offices, shops, ports, and construction. The Act provides for the minister for manpower, development and

labour to make regulations in respect of construction works to address specific hazards including imposing duties on persons in respect of the hazards. Section 57 of the act relates to building and civil engineering works. Other sections relevant to building and civil engineering works specified in section 57 (1) of the Act include: sections 6 to 8, 10 to 12, 19, 20, 25 to 31, 33 to 40, 43 to 54, and 60 to 87. Under the Act, construction businesses are required to register their sites (sections 6-8) and to report workplace accidents and dangerous occurrences to the Factory Inspectorate Department. It also requires them to provide wholesome drinking water on their sites (20), toilet facilities on the sites (19), and personal protective equipment for their workers (25), and to take preventive measures to control or prevent specific hazards onsite. The hazards named are; noise, vibrations, manual handling (26 and 27), and fire (31).The Act also requires medical supervision of the health of employees where necessary.

Businesses are required to take measures at the workplace in respect of access and egress to the factory (site), the construction and design of structures to ensure the safety of workers, and users of facilities (33-35). Fencing and safeguards are required to be provided or constructed and maintained for the safety of persons at the factory (site) (38-40). Records of lifting machines and appliances are required to be to be kept and they must be of sound construction, properly maintained and precautionary measures taken during their operation (37 and 43-47). Construction businesses are required to take precautionary measures to prevent injury and explosions because of dust, gas, vapour, present in the work environment 69 (48 and 49). Steam boilers, receivers and containers, and air receivers are required to be of sound construction, properly maintained and precautionary measures taken to ensure their operation (50).

The Act provides for training of machine operators and persons employed in processes likely to cause injury (36). The Minister may make regulations to protect the health, safety, and welfare of workers (30 and 51). Other sections of the Act which relate to construction works include:

- Sections 52-54 set outs the authority of inspectors in ensuring health, safety and welfare of persons at workplaces and the role the courts play in such matters;
- Sections 60-73 set out the offences under the Act and legal proceedings;
- Sections 74-77 relate to the administration of the Act; and
- Sections 78-87 relate to general matters.

There are a number of concerns regarding the implementation of the Act. First, regulations are needed to set standards for specific situations of the act. In the absence of these standards, employers wishing to comply with the requirements of the law will adopt standards which are very subjective. There is no law defining funding mechanisms for implementing occupational health and safety. Lastly, establishing compliance and enforcement networks is not covered by the Factories, Offices, and Shops Act which is the main occupational health and safety law of the country.

2.7.3 Workmens Compensation Act

The Workmen's Compensation Act 1987 imposes employer liability to pay compensation to employees incapacitated by accidents arising out of and in the course of their employment. Compensation payment to accident victims is independent of negligence on the part of employer or fellow-worker. The employer is also required to bear the hospital expenses of the injured worker. In cases where the injured worker only requires treatment,

he/she is entitled to his/her earnings while undergoing treatment for injuries he/she sustained through an accident arising out of, and in the course of his/her employment. There are exceptions to employers' liability to pay compensation. These exceptions are: where the injury is due to the workman having been under the influence of intoxicating liquor or drugs at the time of the accident or where the injury was deliberately self-inflicted or where the workman knowingly misrepresented to the employer that he was not suffering or had not previously suffered from that or similar injury. The law applies to persons employed by both public and private organizations. The Act sets out modalities for calculation of the earnings of workers and payments of compensations to workers who sustain injuries.

2.7.4 ILO Conventions

Generally, a code of practice is a set of rules according to which people in a particular profession are expected to behave or practice. The ILO's Code of Practice on Health and Safety on Construction site provides guidelines in the implementation of the Health and Safety practice on construction sites for all workers including casual workers. The document outline the steps that have to be taken, among others to provide adequate welfare facilities, personal protective equipment appropriate for a job and provision and maintenance of safe working environment to all workers on site. Salient portions of the code relevant to this study are explained and presented below.

2.7.4.1 Welfare Facilities

Under the general provisions of welfare facilities, it writes "at or within reasonable access of every construction site, the following facilities should, depending on the number of workers and the duration of the work, be provided, kept clean and maintained:

- Sanitary and washing facilities or showers;
- Facilities for changing and for the storage and drying of clothing;
- Accommodation for taking meals and for taking shelter during interruption of work due to adverse weather conditions"

2.7.4.2 Sanitary Facilities

The Sanitary facilities are defined to include toilet, privies, chemical closet. The understanding from the document is that, the provision, the construction and the installation of these facilities should comply with the requirements of the authorities (laws of the land). Further, no toilet other than a water flush toilet should be installed in any building containing sleeping, eating or other living accommodation, and should be adequately ventilated and not open directly into occupied rooms. Adequate washing facilities should be provided as near as practicable to toilet facilities.

2.7.4.3 Washing Facilities

The rules governing washing facilities (e.g. shower-bath) are that, the number and the standard of construction and maintenance of washing facilities should comply with the requirements of the authorities. Washing facilities should not be used for any other purpose

and where workers are likely to be exposed to skin contamination by poisonous, infectious or irritating substances, or oil, grease or dust, there should be a sufficient number of appropriate washing facilities or shower-baths supplied with hot and cold water.

2.7.4.4 Cloakrooms

A cloakroom, or sometimes referred to as coatroom, is by definition a room where coats and other articles may be left temporarily (Harris, 2005**)**. On construction site, the cloakroom is normally part of the site accommodation provided by the main contractor and it should be provided for all workers at easily accessible places and not be used for any other purpose. Cloakrooms should be provided with suitable facilities for drying wet clothes and for hanging clothing. Where necessary the contamination of the room should be avoided. Suitable lockers separating working from street clothes must be provided. Suitable arrangements should also be made for disinfecting cloakrooms and lockers in conformity with the requirements of the authorities.

2.7.4.5 Drinking Water

The code requires that, contractors must provide enough water for all workers and the treatment of the drinking water will be as follows. All drinking water should be from a source approved by the authorities. Where such water is not available, the authorities should ensure that the necessary steps are taken to make any water to be used for drinking fit for human consumption. Drinking water for should be stored in closed containers only, from which the water should be dispensed through taps or cocks. If drinking water has to

be transported to the worksite, the transport arrangements should be approved by the authorities. The transport tanks, storage tanks and dispensing container should be designed, used, cleaned and disinfected at suitable intervals in a manner approved by the authorities. Water that is unfit to drink should be conspicuously indicated by notices prohibiting workers from drinking it. A supply of drinking water should never be connected to a supply of water that is unfit to drink.

2.7.4.6 Facilities for Food and Drink

Contractors are required in appropriate cases, depending on the number of workers, the duration of the work and its location, adequate facilities for obtaining or preparing food and drink at or near a construction site should be provided, if not otherwise available. The facilities should be hygienic and located in hygienic environment.

2.7.4.7 Living Accommodation

The code of practice requires that suitable living accommodation should be made available for all the workers at construction sites which are remote from their homes. Adequate transportation between the site and their homes should be provided, and where this is not possible other suitable living accommodation should be provided. Men and women workers should be provided with separate sanitary, washing and sleeping facilities.

2.7.4.8 Personal Protective Equipment and Protective Clothing

Under this provision, employers were to note that suitable personal protective equipment and protective clothing, having regard to the type of work and risks, should be provided and maintained by them without cost to the workers. Also under this provision, personal protective equipment and protective clothing should comply with standards set by the authorities, taking into account as far as possible the ergonomic principles. Further, employers should provide the workers with the appropriate training to enable them to use the individual protective equipment, and should require and ensure its proper use.

2.8 Summary of Review of Related Literature

This chapter reviews the literature that is related to the focus of the study. Firstly it defined the Construction industry as a group of firms with closely related activities involved in the construction of real estates, building, private and public infrastructure. It also reviewed the various categories the industry can be broken down into and also spoke about the three primary participants of the construction industry namely, the owner, the designer and the contractor. The chapter also identified the various classification or categories of Building contractors according to the Ministry of Water resources, Works and Housing.

The Chapter reviewed literature on accidents in the construction industry with accident statistics from Ghana and other parts of the world. This raised a very alarming situation since literature reviewed showed that the rate of construction accidents have been increasing over the years which is the more reason research on safety has to be treated with all seriousness.

The concept of accidents, the types of accidents and their causes as identified in the literature was further reviewed in this chapter. Casualty error, poor quality kit, site conditions, plant operator error, plant failure, etc. were some of the identified causes of accidents. The chapter also looked at the strategies for preventing construction accidents during the design and the construction stages of a project.

The general theories of accident causation and theories of accident causation in construction and how this helps in making good decisions to prevent work-related accidents on construction sites was also discussed. The chapter looked at some of the advantages derived from ensuring a safe working environment. Some of which are minimizing worker compensation claims and insurance claims, boosting the morale of workers and increasing productivity in the long run.

Finally, the chapter reviewed the regulations aimed at preventing work-related accidents in Ghana. Some of the regulations discussed included the Labour Act, 2003 (Act 651), Factories, Offices and Shops Act, Workmens Compensation Act and the ILO Convention.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter discusses the methods adopted in conducting this research. Generally, to achieve the aim of a study, one of the important areas to consider is the kind of method that is adopted (Naoum, 1998). The methods adopted were captured under the following headings: Research design, target population of the study, sampling procedure and technique, data collection method, questionnaire development, pre-testing of questionnaire, validity and reliability, ethical issues and the analysis of collected data.

3.2 Research Design

Research design, according to Yin (2003), is an action plan for getting from one point to another (from here to there), where here is the question to be answered and there is the conclusion to be drawn". Burns and Grove (2003:195) also defined a research design as "a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings".

The study employed the quantitative approach. The quantitative research method adopts a deductive and objective view, which is characterized by tangible data such as counts, weight, mass, and other physical measures (Fellows and Liu, 2003). It usually includes the investigation of frequencies and different measurable variables with the aim of explaining a certain phenomenon. Its fundamental features are cause-and-effect thinking, hypotheses and questions, and the use of measurements, and it is inclined to be deductive, in other words it tests theory (Yin, 2003).

Quantitative research is generally based on two research methods namely survey and experimentation. The survey method was used for the study. Survey method was chosen because it provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population. It includes cross-sectional and longitudinal studies using questionnaires or structured interviews for data collection—with the intent of generalizing from a sample to a population (Fowler, 2009).

3.3 Target Population of the Study

The study population for this purpose was based on personnel with knowledge of strategies of preventing accidents on construction sites. According to Koul (2002), population is a collection of specified group of human beings or non-human entities.

The targeted population for the study consisted of site managers, from Ghanaian Building Construction firms registered with the Tamale Metropolitan Assembly and were based in Tamale. In all, two hundred (200) construction firms were identified to be in this category to represent the population. This category of construction firms were considered because the research was centered on preventing accidents on construction sites in the Tamale Metropolis.

3.4 Sampling Procedure and Technique

According to Babbie (2004), "a sample is a small subset of a population whose selection is based on the knowledge of the elements of a population and the research purpose". The selection of the subset is done strategically and systematically so that the

units or persons that meet a specific criterion are identified and selected (Merriam and Simpson, 2000; Sapsford and Jupp, 2006). Gay and Diehl (1992), argued that generally the number of respondents acceptable for a study depends on the type of research involved. They indicated that for a descriptive research, the sample size should be 10% or 20% of the population.

To determine the minimum sample size of these registered construction firms in the Tamale Metropolis, de Vaus (2002) formula which gives a procedure for calculating the sample size was applied.

$$n = \frac{N}{1+N(e)^2}$$

Where:

n = sample size,

N= size of Population under study

e = significant level in percentage of error = 0.05

Therefore n determines the sample size of construction firms registered with the Tamale Metropolis Assembly, given that N = 200

$$n = \frac{N}{1+N(e)^2} = \frac{200}{1+200(0.05)^2} = \frac{200}{1.50} = 128$$

n = 128, means that the sample size for construction firms registered with the Tamale Metropolis Assembly to be used for the study is approximately one hundred and twenty-eight (128).

Purposive sampling technique was applied for the selection of the site managers to respond to the questionnaire. This technique is used because Erbil & Akıncıtürk, (2010)

has indicated that, the purposive sampling technique allows the researcher to select the individual who have good knowledge on the subject in discussion. The site manager is responsible for setting up and implementing safety policies. With this it is expected that the respondents will demonstrate good knowledge about the health and safety issues of construction workers.

3.5 Data Collection

Data collection is a term used to describe a process of preparing and collecting data and purpose of these processes is to obtain information to keep on record, to make decisions about important issues, and to pass information on to others. The developed questionnaires were distributed to and retrieved from construction offices and active construction sites in person. This process of distribution and retrieving of the questionnaires in person was taken for two reasons as suggested by Ahadzie (2007), first, to make sure that the questionnaires gets to the intended recipients and secondly, to help improve the response rate. In all some of the questionnaires were collected back on the same day while others were collected later from the respondents.

3.5.1 Questionnaire Development

In order to achieve the aim and objectives of the study, well-structured close-ended questionnaires were designed to gather information from building construction sites in Tamale Metropolis. These questions were ethical and feasible. The wordings were without

bias and the questions provided multiple choice options which gave the respondents the opportunity to present their ideas by way of selecting from the options provided.

Close-ended questionnaires were used because Glasow (2005) has indicated, close-ended questions are easy for respondents to answer and it also help researchers to analyze their data easily. Salant & Dillman, (1994) are also of the view that closed-ended questions with unordered choices, for example the multiple choice questions are useful for ranking items in order of preference.

The information sought was divided into four subheadings:

Part 1:- Personal / company's details (e.g. gender, educational level, age category of workers and working experience in the industry);

Part 2:- Causes of accidents on construction sites;

Part 3:- Accidents prevention strategies on construction sites; and

Part 4:- Occupational health and safety issues (provision of welfare facilities and protective equipment).

In most of these subheadings in the questionnaires, the respondents were to use Likert scale to scale them in other of importance to assess the various factors identified in literature review. The conventional five-points of scaling for respondents, for example were selected as.

- Very important (5 points)
- Important (4 points)
- Neutral (3 points)
- Not important (2 points)
- Not very important (1 point)

3.5.2 Pre-Testing of Questionnaire

The research instrument used were pre-tested in a study using a limited sample size of 10 respondents to ascertain the consistency and reliability of the instrument. The final questionnaire that was distributed therefore contained the relevant information that sufficed for the objectives set for the study.

The researcher ensured that the responses of respondents originated from their own opinions and therefore free from any form of coercion or influence from others. The questionnaire was pre-tested to ascertain whether or not the questions would work well and what questions should be added or discarded.

Through the pre-testing, some questions were restructured and all ambiguous words were addressed. The questionnaire pre-tested comprise 10 site managers selected from the sampled construction firms in the Tamale Metropolis.

3.5.3 Validity and Reliability

Questionnaire items were peer reviewed and cross validated by people with research experience to ensure scale consistency, reliability, and content validity. The use of question items and scales from previous research questionnaires was another way of obtaining quality data for the study. Preliminary findings were also rechecked for accuracy and consistency.

3.5.4 Ethical Issues

Ethical Considerations are very important in the research of this nature. As a result the consent of the participant was sought first as to whether they were interested to participate in the research. The purpose and methodology of the research was explained in detail to the respondents before the research was carried out. The researcher did not in any way forcefully influence the decision of the respondents by cohesion or other means to solicit information against their wishes.

Moreover, data and information collected from the participants were treated as private and confidential. The information given by respondents was used for the purpose of the research only.

3.6 Data Analysis

The Statistical Package for Social Sciences (SPSS) and excel were used for data entry and analysis of the data collected. Data preparation was the initial step to convert raw date into structured format that was more appropriate for the analysis. Tasks in this stage included data editing, data coding and data entry, frequency distributions, percentages, and descriptive analysis of assessing the strategies of preventing work-related accidents on small-scale construction sites in the Tamale Metropolis.

Data collected were collated and analyzed using various quantitative statistical models such as tables, bar chart and pie chart to illustrate the results. The findings were critically examined to ensure consistency with the research objectives.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter deals with analysis, discussion and presentation of results of collected data. Statistical Package for Social Sciences (SPSS) was employed to derive descriptive statistical tools in the form of tables and charts. The analysis is presented in four sections; the first section discussed the socio-demographic data and general organization information. The subsequent sub-sections addressed research objectives; causes of accidents on the construction sites, strategies for the prevention of accidents in the construction sites, awareness of occupational health and safety issues, employees' health and safety rights and responsibilities and the provision of safety items or equipment.

4.2 Response Rate

Out of the 128 questionnaires distributed, 90 were retrieved. Twenty-eight (28) of the returned questionnaires were found to be too badly completed to be useful for the analysis and were therefore discarded. This brought the responses effectively to 62, representing a response rate of 48%. This response rate is considered adequate as, according to Oladapo (2005), Newman & Idrus (2002) and Ellhag and Boussabaine (1999), a response rate of 30% is good enough in construction studies.

4.2.1 Demographic Data of the Respondents

This section of the analysis presented the demographic data of the Respondents. The emphasis were on gender, highest level of education and the number of years respondents have been working. Table 4.1 and Figures 4.1, 4.2 and 4.3 presented the gender, the number of years respondents have been working in the construction industry and their highest level of education respectively.

Table 4.1: Demographic Data of Respondents.

Variable	Frequency	Percentage
GENDER		
Male	59	95.2
Female	3	4.8
Total	62	100
LEVEL OF EDUCATION		
MSc/MTech/MPhil	12	19.4
BSc/BTech	28	45.2
HND	16	25.8
Technician(CTC I, II and III)	6	9.7
Others	0	0
Total	62	100
WORK EXPERIENCE		
Less than 1 year	3	4.8
1 - 5 years	12	19.4
6 years – 10 years	23	37.1
11 years – 15 years	14	22.6
16 years – 20 years	8	12.9
Over 20 years	2	3.2
Total	62	100
AGE CATEGORY		
18 - 20 years	3	4.8
21 – 30 years	24	38.7
31 – 40 years	16	25.8
41 – 50 years	14	22.6
51 – 60 years	5	8.1
Total	62	100

Source: Field study, 2016

4.2.2 Gender of Respondents

The dominance of males in the building industry was revealed by the data as shown in Figure 4.1. Whiles majority (95%) of the population were Males, only (5%) were Females.

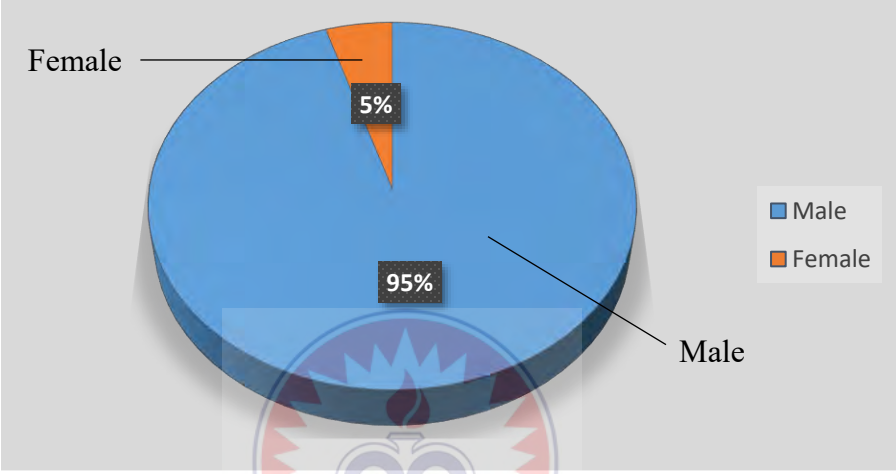

Figure 4.1: Distribution of Respondents by Gender

Source: Field study, 2016

4.2.3 Educational Background of the Respondents

Out of 62 respondents, whiles 12 out of the respondents were Master of Science Degree holders, 28 of the respondents had Bachelor of Science Degree and 16 of the respondents were Higher National Diploma (HND) holders, only six (6) out of the respondents were CTC (I, II and III) holders as shown in Figure 4.2. This showed that majority of the respondents had further or higher education from HND, through BSc to MSc in construction related courses.

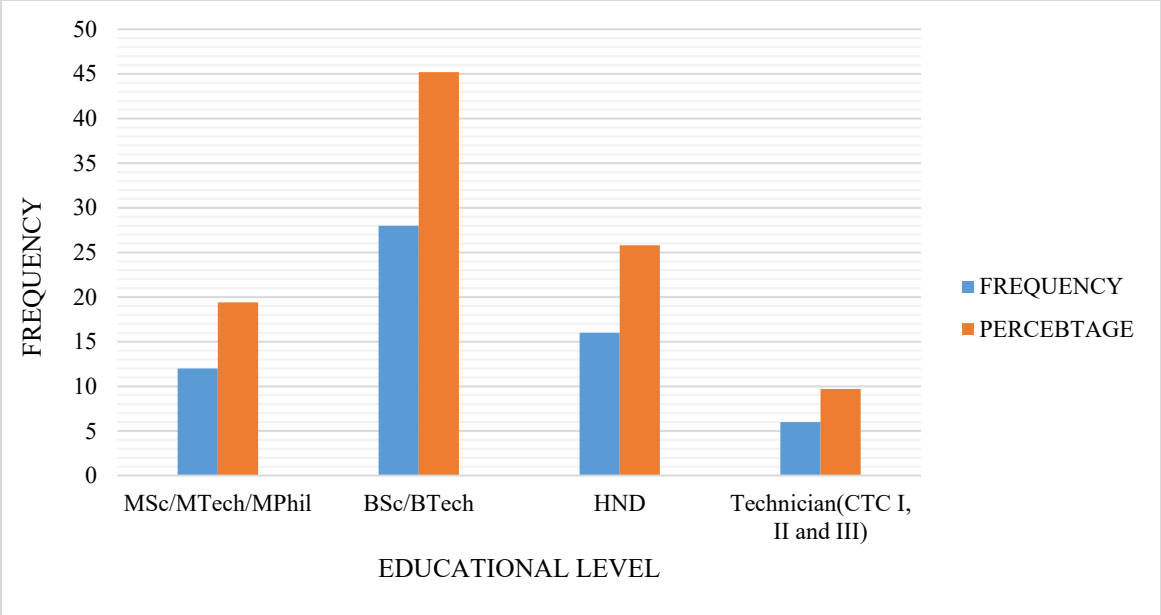

Figure 4.2: Distribution of Respondents by Level of Education

Source: Field study, 2016

4.2.4 Work Experience of Respondents

More than two out of three (72.6%) of the respondents have worked between six to 20 years in the building industry and are more experienced in their field of work as shown in Figure 4.3. This background information gathered on these personnel suggests that they are competent, experienced and capable of exercising good judgment and as such the responses provided by them could be relied upon for study.

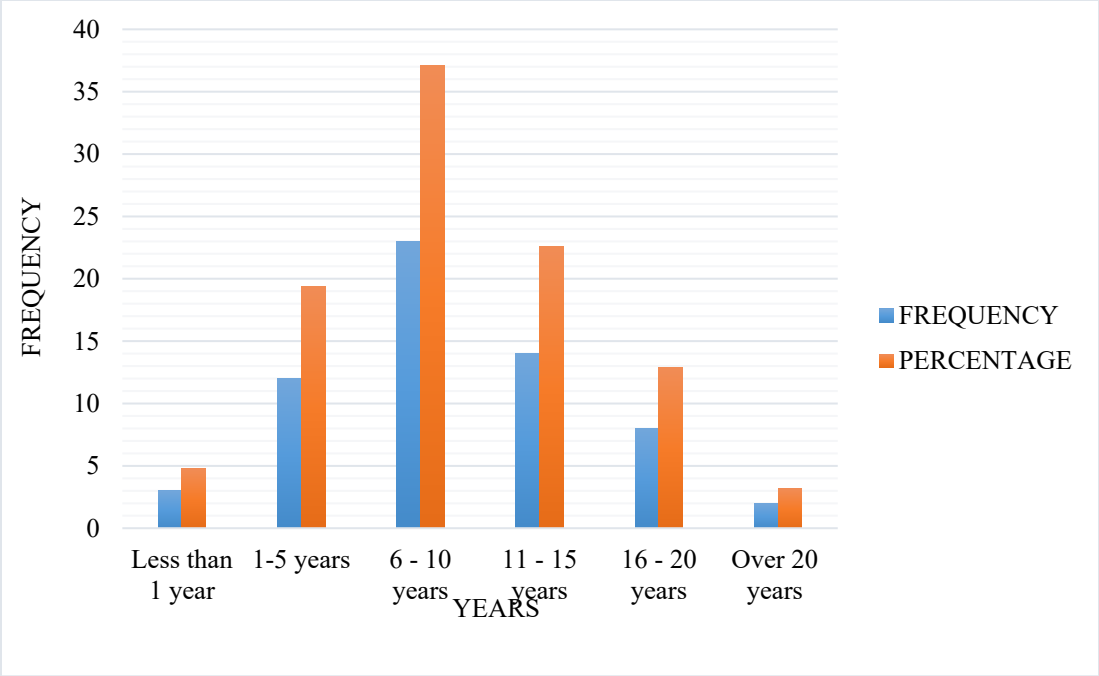

Figure 4.3: Number of Years in Construction Industry

Source: Field study, 2016

4.2.5 Age Category of Respondents

While majority (91.9%) of the population in the building industry were relatively young (between the ages of 18 to 50 years) and are in active service, only few 8.1% were in the advance age category (50 to 60 years) as shown in Figure 4.4.

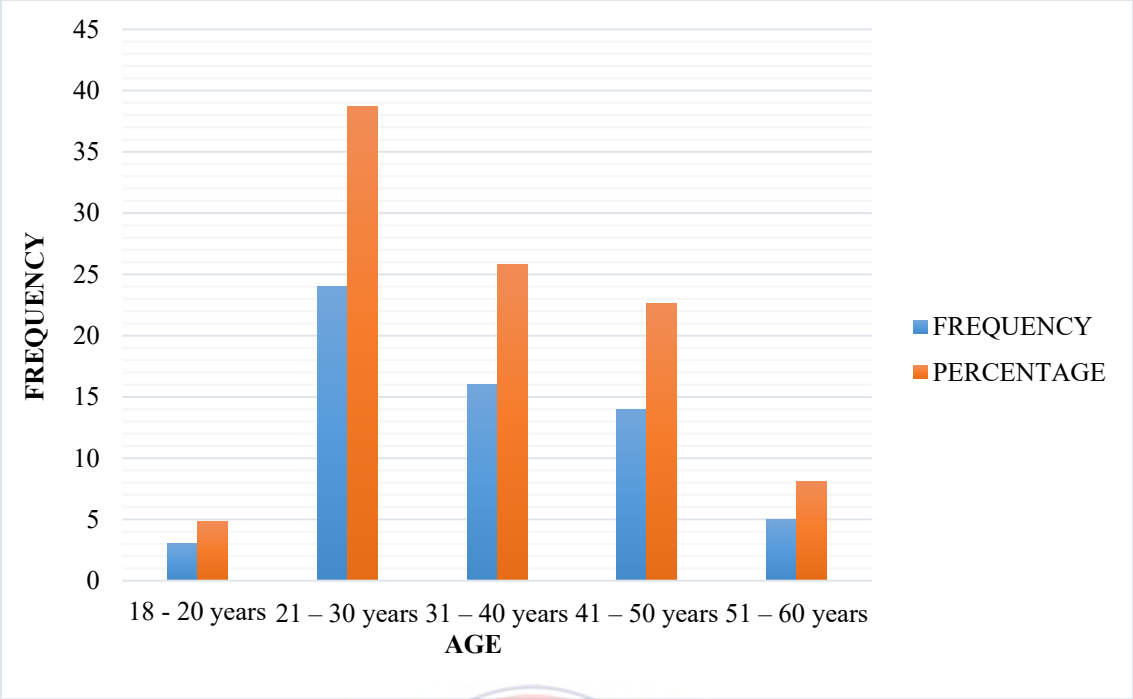

Figure 4.4: Distribution of Respondents by Age Category

Source: Field study, 2016

4.3 Causes of Accidents

The researcher sought to find out from respondents their view on the causes of accidents on building construction sites. The following are some views expressed by the respondents.

i. From Figure 4.1, a total of about 59% of respondents agreed to the statement that the following are the causes of accidents on construction site while an average of about 18% of the respondents disagreed to that assertion.

ii. About four out of five (81.8%) of the respondents asserted that workers negligence is the main cause of accidents on construction sites. While (7.3%) remained neutral, only few (10.9%) of them disagree with the assertion.

iii. Among other causes, indications from Table 4.2 suggests that lack of workers' knowledge and skills, Poor site management, Negative attitude of workers, Non-compliance with standard safety rules and regulations, Workers operating environment, Improper supervision were the main causes of accidents on construction sites.

iv. Whiles less than half (49.1%) of the respondents agree with the assertion that lack of experience on the part of workers is one of the cause of accidents on construction sites, only few 29.1% disagree with the assertion and 21.8% remained neutral.

Table 4.2: Causes of Accidents in the Construction Site

Accident causes	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Workers' negligence	50.9	30.9	7.3	0	10.9
Failure to obey work procedures as well as incorrect work procedures	47.3	10.9	16.4	9.1	16.4
Nature of work being performed (work at heights)	36.4	18.2	20.0	9.1	5.5
Equipment without safety devices	34.5	25.5	21.8	9.1.	9.1
Poor site management	38.2	29.1	16.4	3.6	3.6
Lack of workers' knowledge and skills	32.7	30.9	21.8	7.3	3.6
Negative attitude of workers	34.5	25.5	20.0	5.5	5.5
Use of faulty tools and equipment	32.7	20.0	30.9	9.1	7.3
Non-compliance with standard safety rules and regulations	32.7	25.5	18.2	10.9	9.1
Improperly maintained and adequate scaffolding	30.9	25.5	25.5	12.7	5.5
Lack of experience	29.1	20.0	21.8	16.4	12.7

Improper handling and storage of flammables, explosives and combustibles	32.7	21.8	20.0	12.7	12.7
Workers fatigue and boredom	32.6	20.6	25.2	13.7	7.9
Improper supervision	30.5	26.2	18.9	12.4	12.0
Management attitude and actions on safety matters	26.6	28.8	23.9	13.8	6.9
Workers operating environment	32.7	30.9	20.0	9.1	7.3
Natural causes (rainstorm, flood etc.)	27.8	25.4	26.8	10.9	9.1
Inadequate management of work environment	30.2	29.7	21.7	10.1	8.3
Faults in design, detailing and specifications	30.4	28.6	22.5	9.7	8.8
Faulty construction techniques	31.5	25.8	24.8	10.6	7.8
Workers physical conditions	29.8	27.5	23.8	11.8	7.1
Lack of job satisfaction by workers	27.8	26.8	25.2	10.7	9.5
Monotony (constant exposure to particular job)	31.8	27.7	23.1	11.2	6.4
Poor general site cleanliness	31.4	28.1	24.8	10.6	5.1
Failure to backfill holes and trenches promptly	29.5	28.1	20.6	11.2	10.6
Average Ratings	**33**	**26**	**22**	**10**	**8**

Source: Field study, 2016

4.4 Accident Prevention Strategies

Half (50%) of the respondents agreed to the assertion that applying the accident prevention strategies as shown in Table 4.3 would help reduce accidents on site. Whiles an average of more than half (59%) of the respondents admitted to the assertion that almost all the accident strategies are important in the prevention of accidents on site, only a few (17.2%) asserted that three of the strategies does not have any influence on accident prevention on site. This strategies includes request for safety gadgets before work starts, workers use safety equipment issued them and safety personnel on site to check the usage of safety

equipment. Few (18%) of the respondents also disagreed to the assertion that applying the accident prevention strategies as shown in Table 4.3 would help reduce accidents on site

Table 4.3: Accident Prevention Strategies

Accident prevention strategies	Very Important	Important	Neutral	Not Important	Not Very Important
Have knowledge of your right on health issues as a worker.	26.7	25.8	10.9	14.5	22.1
Request for safety gadgets before work starts.	11.3	3.8	37.7	41.5	5.7
Workers use safety equipment issued them.	10.9	9.1	40.0	25.5	14.5
Safety personnel on site to check the usage of safety equipment.	5.5	10.9	12.7	38.2	30.9
Have training on health and safety issues.	36.4	20.0	7.3	12.7	23.6
Training impacts on the lives of workers.	47.3	20.0	20.0	3.6	9.1
First aid promptly administered when accident occurs.	38.2	25.5	21.8	7.3	7.3
Have proper understanding of warning signs at the workplace.	36.4	16.4	29.1	9.1	9.1
Provision of safe storage of flammables, explosive and combustibles	45.5	10.9	12.7	16.4	14.5
Use of experienced field supervisors for enforcing safety rules for workers	40.0	16.4	10.9	20.0	12.7
Encouragement of strict compliance to company safety rules for workers	41.8	16.4	10.9	20.0	10.9
Conducting periodic safety seminars	50.9	18.2	7.3	12.7	10.9
Safety campaigns using posters, safety instruction cards, warning signs etc.	38.2	25.5	21.8	7.3	7.3
Special safety instructions for particular tasks	36.8	17.6	12.9	20.0	12.7
Average Ratings	**33**	**17**	**18**	**17**	**14**

Source: Field study 2016

4.5 Health and Safety Issues confronting construction workers

From Figure 4.5, an average of 79.6% admitted that occupational health and safety issues were of much concern to them. These respondents claimed that it was very important for them to be aware of their rights on health and safety issues as workers, have training on health issues that would promote good health and ensure safety at the work place. The respondents also affirmed that if first aid is readily available at the work place and promptly administered when accidents occur it would boost the morale of workers for them to give out their best.

Finally, these same respondents confirmed that a good understanding of warning signs displayed at the construction site would help reduce injuries and accidents to both workers and people in the community. An average of 10.4% of the respondents asserted that these health and safety issues were not important while an average of 10% remained neutral.

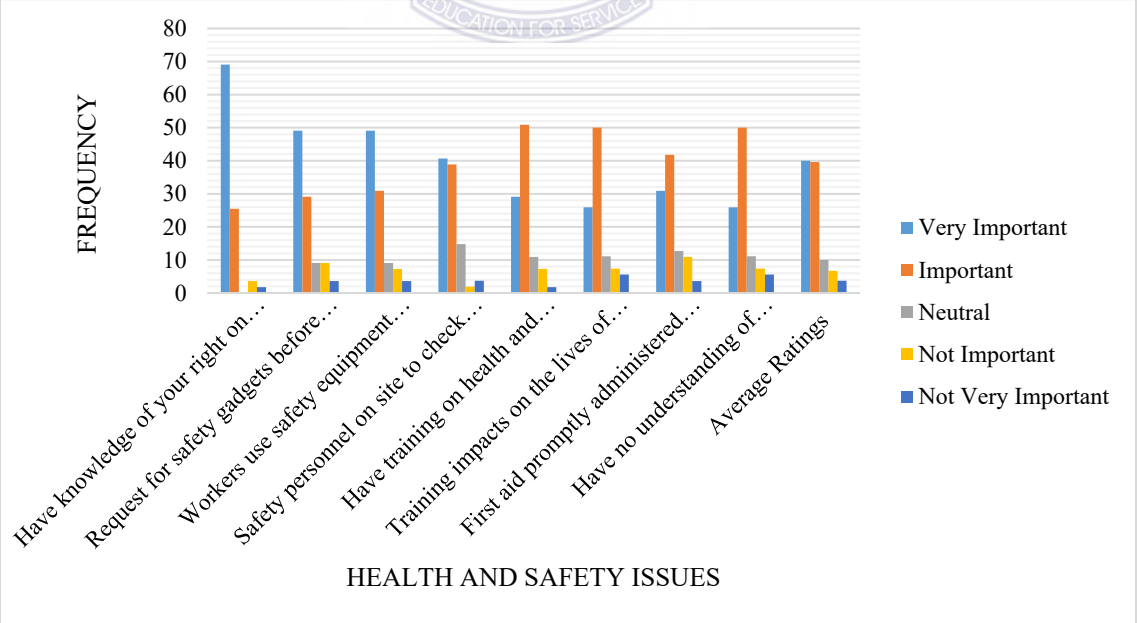

Figure 4.5: Health and safety issues

Source: Field study, 2016

4.5.1 Employees' Health and Safety Rights and Responsibilities

As a worker if you have reasonable concerns about your safety, to stop work and leave your works, Employers have legal obligations to ensure a safe and healthy workplace. As an employee, you have rights, and you have responsibilities for your own well-being and that of your colleagues.

Your rights as an employee to work in a safe and healthy environment are given to you by law, and generally cannot be changed or removed by your employer. The most important rights are, as far as possible, to have any risks to your health and safety properly controlled;

To be provided, free of charge, with any personal protective and safety equipment.

i. Area, without being disciplined.

ii. To tell your employer about any health and safety concerns you have.

iii. To get in touch with the Health and Safety Executive (HSE) or your local authority if your employer would not listen to your concerns, without being disciplined.

iv. To have rest breaks during the working day, to have time off from work during the working week, and to have annual paid holiday.

v. Employers have some flexibility to manage their financial exposure arising from the potential liabilities under the Act. It is not mandatory for employers to buy insurance for employees who are newly covered under the Act Nonetheless, employers will be

vi. Required to pay compensation in the event of a valid claim, even if they do not buy insurance.

vii. There is no change to the compulsory insurance requirement for

viii. employees who are already covered by the Act

ix. Employers are required by law to buy insurance for these employees, unless exempted.

Despite this variety of concerns and interests, certain basic principles can be identified, including the following:

All workers have rights. Workers, as well as employers and governments, must ensure that these rights are protected and foster decent conditions of labour. As the International

Labour Conference stated in 1984:

a. work should take place in a safe and healthy working environment;

b. conditions of work should be consistent with workers' well-being and human dignity;

c. Work should offer real possibilities for personal achievement, self-fulfillment and service to society.

4.5.2 Training

One of the ways in which employers meet legal obligations to impart health and safety information to protect workers is through training. A recent systematic review by the Institute for Work & Health (IWH) concluded workplace training and education have a positive impact on the health and safety practices of workers (Robson et al, IWH, 2010). There was, however, insufficient evidence that training on its own reduced injury rates. These findings support the multi-faceted approach set out in the recommendations of the Panel: filling gaps in training requirements, promoting key elements of OHS performance such as management commitment, encouraging worker participation, influencing societal norms, and creating processes to identify and remove hazards. To make significant improvements to workplace health and safety, all of these elements are necessary.

The public consultations revealed that there is a lack of foundational, basic information among workers about the existence of "the green book" that Ontario has an Occupational Health and Safety Act; and that owners, employers, supervisors and workers all have rights and responsibilities. In the view of the Panel, everyone needs to be aware of these rights and responsibilities, regardless of their role within the workplace.

4.5.3 Provision of First-Aid

The rule is that employers are to provide first-aid facility for every employee on a work site. It is required by law that employers are to provide first-aid room properly constructed and accessible for purpose of rest and treatment, and it should be operational during working hours. This is applicable to contractors who employ 250 and more

employees. There is also a legal requirement that obliges employers to draw Compulsory Insurance against injuries and fatal accidents that may occur at workplaces.

4.6 Provision of Safety Items or Equipment

Employers are required by law to provide all categories of workers with the following personal protective equipment and protective clothing on site.

i. Safety helmets or hard hats to protect the head from injury due to falling or flying objects, or due to striking against objects or structures;

ii. Clear or coloured goggles, a screen, a face shield or other suitable device where workers are likely to be exposed to eye or face injury from airborne dust or flying particles, dangerous substances, harmful heat, light or other radiation, and in particular during welding, frame cutting, rock drilling, concrete mixing or other hazardous work;

iii. Protective gloves or gauntlets, appropriate barrier creams and suitable protective clothing to protect hands or the whole body as required, against heat radiation or while handling hot, hazardous or other substances which might cause injury to the skin;

iv. Footwear of an appropriate type when employed at places where there is the likelihood of exposure to adverse weather conditions, or of injury from falling or crushing objects, hot or hazardous substances, sharp-edged tools or nails and slippery or ice- covered surfaces;

v. Respiratory protective equipment, suitable for a particular environment, where workers can be protected against airborne dust, fumes, vapours or gases by ventilation or other means;

vi. a suitable airline or self-contained breathing apparatus when employed in places likely to have an oxygen deficiency;

vii. Respirators, overalls, head coverings, gloves, tight-fitting boiler suits, impermeable footwear and aprons appropriate to the risks of radioactive contamination in areas where unsealed radioactive sources are prepared or used; and

viii. Waterproof clothing and head coverings when working in adverse weather conditions.

From the above section, it can be concluded that the legal framework (i.e. the ILO's Code of Practice on Health and Safety on Construction site) for construction workers in general is adequate to protect them. This legal framework covers both permanent and casual workers.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Following the analysis and discussion of the survey data in chapter four, this chapter summarizes the major findings from the study. Based on the obtained results, conclusions were drawn from the causes of accidents and the strategies for preventing accidents on the construction site and recommendations for further study were outlined.

5.2 Summary of Findings

After a careful study and analysis of the results of the study, the following findings were deduced and summarized to enable the reader to get the tangible picture of the whole study. The summary of findings is presented under the following themes;

5.2.1 What are the Causes of Accidents on Construction Sites in the Tamale Metropolis?

The main findings of study in relation to the causes of accidents on construction site were;

- More than half of the respondents are of the view that workers negligence, equipment without safety devices, poor site management, negative attitude if workers, use of faulty tools and equipment, workers fatigue and boredom, improper supervision, management attitude and actions on safety matters, inadequate management if work environment among others are some of the causes of accidents on construction sites.

- The study also revealed that about four out of five of the respondents asserted that workers negligence is the main cause of accidents on construction sites. It can be anticipated that if care is taken during construction works the rate of accidents on site can be reduced.
- The study also recorded that lack of experience on the part of workers has caused accidents on construction sites.

5.2.2 What Effective Strategies can be employed to Prevent or Minimize Accidents on Construction Sites in the Tamale Metropolis?

- Half (50%) of the respondents affirmed that applying the accident prevention strategies would help reduce accidents on construction sites. Some of these strategies includes knowledge on the rights on health issues as a workers, training on health and safety issues, first aid promptly administered when accidents occurs, proper understanding of warning signs at the workplace, provision of safe storage of flammables, explosives and combustible, conducting periodic safety seminars and safety campaigns using posters, safety instructions cards, warming signs among others.
- The study also revealed that all the accidents prevention strategies are important in the prevention of accidents on construction sites. The strict adherence to these strategies during constructional work would help reduce accidents.

5.2.3 What are the Occupational Health and Safety (OHS) Issues Confronting Construction Workers in the Industry and how can this be Managed Efficiently to enhance Productivity?

- The survey revealed that it was very important for construction workers to be aware of their rights on health and safety issues as workers and to have the requisite training on health issues that would promote good health and ensure safety at the work place.
- The respondents also affirmed that if first aid is readily available at the work place and promptly administered when accidents occur it would boost the morale of workers for them to give out their best.
- Finally, these same respondents confirmed that a good understanding of warning signs displayed at the construction site would help reduce injuries and accidents to both workers and people in the community.

5.3 Conclusion

Understanding the strategies for preventing accidents on construction sites will not only help researchers scale up their evaluation of the contributions of accident prevention to the progress of work on the construction site, but it will also provide fundamental knowledge for policy makers to formulate informed and effective decisions.

The study observed that majority of the respondents have adequate knowledge of the causes of accidents in construction sites. According to the respondents, there was no detailed record of the root causes of the accidents that occur on their sites, the only information available on some sites is the type of injury that was sustained.

It was also revealed that most of the construction companies did not have safety officers on their projects. The sampled construction companies had their questionnaires answered by site managers which gives the indication that they had no safety officers.

It was also evident that, there were accident prevention strategies identified on the construction sites of the selected respondents which can contribute to the reduction of accidents on sites. knowledge on the rights on health issues as a workers, training on health and safety issues, first aid promptly administered when accidents occurs, proper understanding of warning signs at the workplace, provision of safe storage of flammables, explosives and combustible, conducting periodic safety seminars and safety campaigns using posters, safety instructions cards, warming signs were the commonest strategies identified by the respondents.

Nevertheless, workers having knowledge of their right on health issues, request for safety gadgets before work starts, workers use safety equipment issued them, safety personnel on site to check the usage of safety equipment, training on health and safety issues and first aid promptly administered when accident occurs were found to be multifarious interventions more likely to reduce accidents on construction sites.

In all, the contributions of accident prevention to the progress of work on the construction site and its potential effects on the development process cannot be underestimated. This calls for a holistic approach to the construction industry in order to unleash its potential for accelerated growth and development.

5.4 Recommendations

Based on the findings and the conclusions drawn, the researcher has formulated the following recommendations to help prevent accidents on construction sites in the Tamale Metropolis.

- Management of construction firms should be more committed towards ensuring safety in their firms. All top managers down to the line of supervisors must prioritize the safety of workers the same way they prioritize work quality and productivity. Without this clear commitment, accidents prevention will very likely be compromised.
- Contractors of the various construction firms should be encouraged to set up Human Resource and Safety Departments for the purpose of executing safety education campaigns and training programmes for all levels of management and site workers. The training is to deliver the content of how important these welfare facilities and safety materials are to the firms and to the health of the workers. Safety education, on the other hand, transfers the concepts of reasons workers have to work safely and the effects of not adhering to safety measures on site. Since the training involves workers, educational and training programmes will have to include the use of films or slides show. This will help site workers have a better understanding of matters relating to health and safety.
- The establishment of safety department will also monitor the use of safety materials and this will enhance safety awareness, which in turn leads to creating a safe working environment and a successful project.

- Safety Officers from Ghana Labour office should liaise with the Ministry of Water Resources, Works and Housing and in conjunction with the Association of Civil Engineering and Building Contractors, regularly visit construction sites to ensure the enforcement of laws governing the provision of welfare facilities and safety materials, employment, and rights of workers.
- Five to ten minutes each morning be apportioned for briefing on health and safety to all workers, especially site workers, before commencement of work, to inculcate in them safety awareness, and improving safety on construction sites.
- Contractors should ensure all job site accidents are reported to top management in order to examine the root cause of such accidents. Results of these investigations must be communicated to all staff and workers through safety meetings in order to prevent future occurrence of such accidents.
- Contractors should ensure they provide the required safety materials and equipment for their workers and should also make sure the workers use and wear them correctly when working. Some of these safety materials are personal protective equipment (Hard hats, safety boots, nose masks, ear guards, etc.), safety signs and flash lights.

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APPENDIX

UNIVERSITY OF EDUCATION, WINNEBA
COLLEGE OF TECHNOLOGY EDUCATION
DEPARTMENT OF CONSTRUCTION AND WOOD TECHNOLOGY
SURVEY QUESTIONNAIRE

STRATEGIES TO MITIGATE THE CAUSES OF CONSTRUCTION ACCIDENTS IN THE TAMALE METROPOLIS: PERSPECTIVES OF SITE MANAGERS

Dear Sir/Madam,

This questionnaire forms part of an MTech. Research project which aims to **examine the strategies to mitigate the causes of construction accidents in the Tamale Metropolis: perspectives of site managers.** I would like to invite you to participate in the above project. Completion of the questionnaire is completely voluntary and returning the completed questionnaire will be considered as your consent to participate in the survey. Please you are kindly being asked to respond to this questionnaire frankly as possible as you can. The questionnaire will take you about 5 minutes to complete. I appreciate that you are already busy and that participating in this survey will be another task to add to a busy schedule, but by contributing you will be providing important information. **All data held are purely for research purposes and will be treated as strictly confidential.**

Thank you for your time and valid contribution in advance.

Yours faithfully,

John Bosco Kubati Nyamador
Email: fox.cubati@gmail.com
Mobile; 0243035046 / 0200555163

Part 1: PERSONAL / PROJECT DETAILS

1. Please indicate your gender. *Please tick [√] the appropriate option.*

a. Male [ ]

b. Female [ ]

2. What is your highest educational attainment? *Please tick [√] the appropriate option.*

a. MSc/MTech/MPhil [ ]

b. BSc/BTech [ ]

c. HND [ ]

d. Technician (CTC I, II and III) [ ]

e. Others please specify_____

3. How long have you been working with your establishment? *Please tick [√] the appropriate option.*

a. less than 1 years [ ]

b. 1 - 5years [ ]

c. 6 - 10 years [ ]

d. 11 - 15 years [ ]

e. 16 - 20 years [ ]

f Over 20 years [ ]

4. What is the age category you belong? *Please tick [√] the appropriate option.*

a. 18- 20 years [ ]

b. 21-30 years [ ]

c. 31- 40 years [ ]

d. 41-50 years [ ]

e. 51-60 years [ ]

Part 2: CAUSES OF ACCIDENTS

5. There is general assertion that the following are the causes of accidents on construction sites. Please indicate your reaction to each statement by ticking [√] the appropriate cell.

Accident causes	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Workers' negligence	[ ]	[ ]	[ ]	[ ]	[ ]
Failure to obey work procedures as well as incorrect work procedures	[ ]	[ ]	[ ]	[ ]	[ ]
Nature of work being performed (work at heights)	[ ]	[ ]	[ ]	[ ]	[ ]
Equipment without safety devices	[ ]	[ ]	[ ]	[ ]	[ ]
Poor site management	[ ]	[ ]	[ ]	[ ]	[ ]
Lack of workers' knowledge and skills	[ ]	[ ]	[ ]	[ ]	[ ]
Negative attitude of workers	[ ]	[ ]	[ ]	[ ]	[ ]
Use of faulty tools and equipment	[ ]	[ ]	[ ]	[ ]	[ ]
Non-compliance with standard safety rules and regulations	[ ]	[ ]	[ ]	[ ]	[ ]
Improperly maintained and adequate scaffolding	[ ]	[ ]	[ ]	[ ]	[ ]
Lack of experience	[ ]	[ ]	[ ]	[ ]	[ ]
Improper handling and storage of flammables, explosives and combustibles	[ ]	[ ]	[ ]	[ ]	[ ]
Workers fatigue and boredom	[ ]	[ ]	[ ]	[ ]	[ ]
Improper supervision	[ ]	[ ]	[ ]	[ ]	[ ]
Management attitude and actions on safety matters	[ ]	[ ]	[ ]	[ ]	[ ]
Workers operating environment	[ ]	[ ]	[ ]	[ ]	[ ]
Natural causes (rainstorm, flood etc)	[ ]	[ ]	[ ]	[ ]	[ ]
Inadequate management of work environment	[ ]	[ ]	[ ]	[ ]	[ ]

Faults in design, detailing and specifications	[ ]	[ ]	[ ]	[ ]	[ ]
Faulty construction techniques	[ ]	[ ]	[ ]	[ ]	[ ]
Workers physical conditions	[ ]	[ ]	[ ]	[ ]	[ ]
Lack of job satisfaction by workers	[ ]	[ ]	[ ]	[ ]	[ ]
Monotony (constant exposure to particular job)	[ ]	[ ]	[ ]	[ ]	[ ]
Poor general site cleanliness	[ ]	[ ]	[ ]	[ ]	[ ]
Failure to backfill holes and trenches promptly	[ ]	[ ]	[ ]	[ ]	[ ]

Others please specify; ……

Part 3: ACCIDENT PREVENTION STRATEGIES

6. There is general assertion that the following strategies minimize or prevent accidents on construction sites. Please indicate your reaction to each statement by ticking [√] the appropriate cell.

Accident prevention strategies	Very Important	Important	Neutral	Not Important	Not Very Important
Have knowledge of your right on health issues as a worker.	[ ]	[ ]	[ ]	[ ]	[ ]
Request for safety gadgets before work starts.	[ ]	[ ]	[ ]	[ ]	[ ]
Workers use safety equipment issued them.	[ ]	[ ]	[ ]	[ ]	[ ]
Safety personnel on site to check the usage of safety equipment.	[ ]	[ ]	[ ]	[ ]	[ ]
Have training on health and safety issues.	[ ]	[ ]	[ ]	[ ]	[ ]
Training impacts on the lives of workers.	[ ]	[ ]	[ ]	[ ]	[ ]
First aid promptly administered when accident occurs.	[ ]	[ ]	[ ]	[ ]	[ ]
Have proper understanding of warning signs at the workplace.	[ ]	[ ]	[ ]	[ ]	[ ]
Provision of safe storage of flammables, explosive and combustibles	[ ]	[ ]	[ ]	[ ]	[ ]
Use of experienced field supervisors for enforcing safety rules for workers	[ ]	[ ]	[ ]	[ ]	[ ]
Encouragement of strict compliance to company safety rules for workers	[ ]	[ ]	[ ]	[ ]	[ ]
Conducting periodic safety seminars	[ ]	[ ]	[ ]	[ ]	[ ]

Safety campaigns using posters, safety instruction cards, warning signs etc.	[ ]	[ ]	[ ]	[ ]	[ ]
Special safety instructions for particular tasks	[ ]	[ ]	[ ]	[ ]	[ ]

Others please specify; ……

Part 4: OCCUPATIONAL HEALTH AND SAFETY ISSUES

7. Please in a scale of Very important to Not very important, indicate the extent to which the following statements influence your health and safety issues on construction site. Please Tick [√] the appropriate cell

Health and safety issues	Very Important	Important	Neutral	Not Important	Not Very Important
Have knowledge of your right on health issues as a worker.	[ ]	[ ]	[ ]	[ ]	[ ]
Request for safety gadgets before work starts.	[ ]	[ ]	[ ]	[ ]	[ ]
Workers use safety equipment issued them.	[ ]	[ ]	[ ]	[ ]	[ ]
Safety personnel on site to check the usage of safety equipment.	[ ]	[ ]	[ ]	[ ]	[ ]
Have training on health and safety issues.	[ ]	[ ]	[ ]	[ ]	[ ]
Training impacts on the lives of workers.	[ ]	[ ]	[ ]	[ ]	[ ]
First aid promptly administered when accident occurs.	[ ]	[ ]	[ ]	[ ]	[ ]
Have no understanding of warning signs at the workplace.	[ ]	[ ]	[ ]	[ ]	[ ]

Others please specify; ……

THANK YOU