LEVEL OF KNOWLEDGE AND USAGE OF SAFETY ASSURANCE TOOLS AND TECHNIQUES BY BUILDING CONTRACTORS IN GHANA

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DECLARATION

I do hereby declare that this dissertation is the result of my own research work carried out. This work is the true reflection of the task I set out to accomplish and have duly acknowledged all sources from which references were drawn. It has not been presented either in Ghana or elsewhere for any diploma, degree or postgraduate programme. I accept all errors and omissions as my own entirely.

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DEDICATION

The Almighty God deserves special praise for granting me the strength and vital energy to combine family life, office work and academic activities. I am really most grateful to my maker.

Then my parents, siblings, children and other members of my family for their patience, sacrifices and prayers which enabled me to go through the course successfully.

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I love you all.

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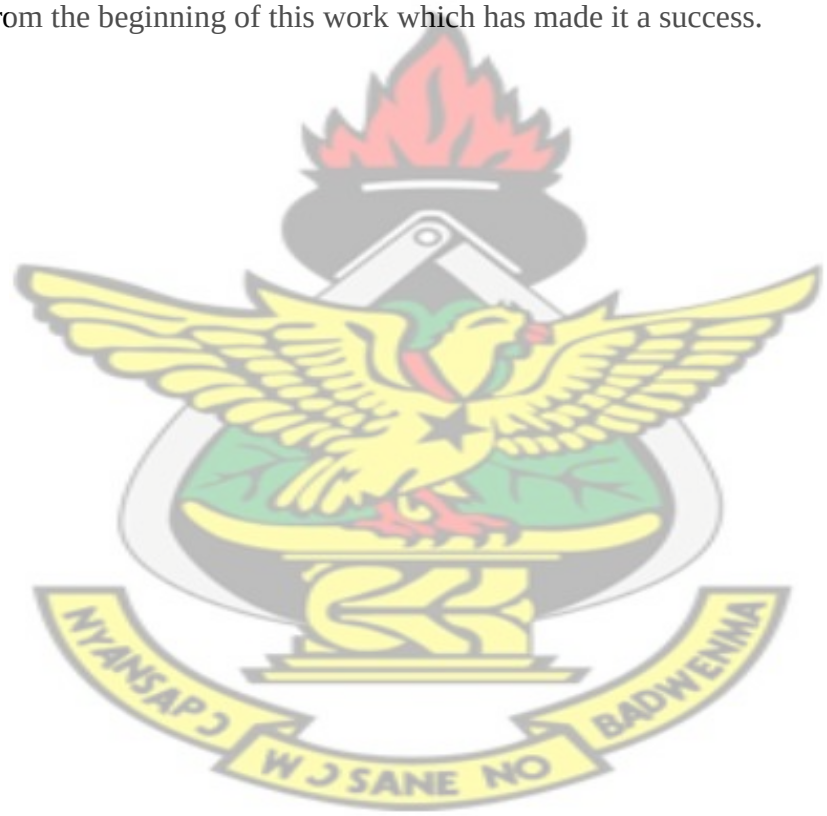

ABSTRACT

Despite the enormous contributions of construction industry to the development of economies, the industry is also saddled with risk and safety issues among other things. Consequently, the industry has been tagged as volatile contributing to highest number of fatalities; and the situation is worse in the Ghanaian Construction Industry. As a result, several safety measures have been put in place to somewhat curb the level of accidents. The study is tailored to aim at improving safety assurance of contractors in Ghana. A mixed methodology approach was used to gather data on the subject area. The study employed questionnaire survey to elicit views on the subject area from construction professionals within the outfit of D1K1 and D2K2 contractors. Subsequently, the data gathered was analysed using descriptive statistics. The dependent variables were analysed using Relative Index (RI), mean score and standard deviations to examine the extent of agreement amongst the various respondents. Overall, the findings revealed a low level of awareness of safety assurance tools and techniques. More so, safety assurance practices in the various companies were identified to be low. In summary, respondents are not committed to safety assurance on construction sites. The study recommends among other things, the need for the establishment of a central agency with legislative authority to enforce safety assurance in the Ghanaian construction industry. The study explored the relatively grey area of safety practices in the Ghanaian construction industry and adds to the already existing knowledge in the discipline.

Keywords: Safety, Safety Assurance, Construction Industry, Safety Tools and Techniques.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

In the construction industry around the globe, the number of injuries and deaths are at an unacceptable level (Dingselay 2006).Construction has the highest number of fatalities and is the most dangerous form of regular employment (Moore, 2013). In every human endeavor, there are hazards or risk involved. Some of these risks can be identified before it occurs and others, until it occurs, cannot be known. However, in both cases, the occurrences of hazards have a toll on human life, productivity, cost, profit etc. The numerous injuries and deaths occurring in the construction industry can be controlled and reduced to the barest minimum if not eliminated completely.

When compared to the manufacturing industry, construction is often classified as a high-risk industry because it has historically been plagued with much higher and unacceptable injury rates (Rowlinson, 2004). On-site employees, arguably those at greatest risk of injury, have not been receiving a consistent and clear message on safety. This inconsistency has in part been due to the movement of subcontractors and workforce between construction companies, projects and sites making it difficult for any one company to consistently influence the attitude and behavior of its mobile workforce.

Recognition of the need to further improve occupational safety performance within the Ghanaian construction industry has led to some companies to adopt the safety culture concept to change safety behaviors. However, the principles of safety culture are challenging to apply in practice (Dingsdad et al., 2006). The major way of controlling the numerous hazards in the construction industry is the act of practicing safety or inculcating safety on site and into construction

respectively. While construction sites are always filled with danger, proper knowledge on safety rules and regulations can be the only thing protecting an individual from certain serious injuries (Perez, 2013).

1.2 PROBLEM STATEMENT

On construction sites in general there are always minor accidents involving workers and sometimes major accidents involving workers and plants. Accident, be it minor or major, affects work in general in terms of productivity, time, cost and even efficiency. The issue of construction site safety has engaged both practitioners and researchers for a long time. A study by Laryea (2010) reveals a poor state of health and safety on Ghanaian construction sites. The study indicated that injuries and accidents are common on sites. One reason advanced for this was the poor enforcement of health and safety procedures. Other researchers have also argued that the construction industry is essentially very different from the manufacturing Industry and so it is impossible for the techniques and systems used in those industries to be effective in the construction industry. However, this argument does not lead to the conclusion that construction work cannot be safe. This would be an inappropriate conclusion but, for such improvements to be made, it would be necessary to adopt innovative and specifically focused measures for the construction industry.

In Ghana, this has been one of the major setbacks in the construction industry on site. Construction in Ghana can be enhanced to yield better results if issues on safety are taken more serious. Site safety practices are of a significant importance on every construction site. Safety assurance of contractors is one way to boost the morale of site workers and assure the client involved that safety practices will be implemented on site. This study thus seeks to explore how safety assurance of contractors can be improved in the Ghanaian construction industry.

1.3 AIM

The aim of this research is to improve on safety assurance by contractors in Ghana through the exploration of the tools and techniques used for same.

1.4 OBJECTIVES

The objectives of this research are:

1. To assess the level of knowledge of building contractors in Ghana on safety assurance tools and techniques
2. To assess the level of usage of safety tools and techniques by building contractors in Ghana
3. To identify practical measures to improve safety assurance by building contractors in Ghana

1.5 JUSTIFICATION

The research has both a theoretical and practical significance. In order to add to intellectual works in the developing country, this study addresses this intellectual deficit by testing the use and level of safety assurance tools and techniques in the Ghanaian construction setting. This will strengthen the literature on construction health and safety with empirical evidence for the industry and academia. Practically this study encourages top level management and construction managers to identify practical measures to improve safety assurance by building contractors in Ghana. This will position the industry to benefit not only from the usage of these tools but curb the rate of construction accidents and its resultant effect on construction time and cost. This study will also provide profound opportunity for construction site workers to benefit from improved safety on construction sites.

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1.6 BRIEF METHODOLOGY

This research adopted desk top study to gather data. Through the desk top study, pertinent literature in the area of safety assurance was identified. A quantitative approach was adopted for gathering data from primary sources. This necessitated primary data to be collated through the use of close ended questionnaires. A suitable sampling technique was adopted and the sample space determined. Gathering of data from secondary sources was done using a qualitative approach. Secondary data was made up of relevant literature about construction health, safety and the seven basic safety assurance tools and techniques. The use of descriptive statistics and relative importance index was used to analyse the data and aid in the discussion of the findings from the study.

1.7 SCOPE OF STUDY

The research emphasized on the usage and level of safety assurance tools and techniques by building contractors. Geographically, the research was limited to only building contractors in the Ashanti Region and identified by the Ministry of Works and Housing as D1K1and D2K2.

1.8 RESEARCH ORGANISATION

This study was presented in five chapters. The first chapter contains the introduction, statement of problem, the significance and organization of the study. The second chapter deals with various theories on motivation and the factors which enhance construction workers productivity. The third chapter describes the methodology adopted for the study including sampling technique used to determine the sample size, the population studied, and the instrument used. The fourth chapter is the analysis of data and the fifth chapter presented the summary of findings, conclusions and recommendations based on the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

There has been some existing literature relating to the topic under research. Before the research can be unique or different from existing work of similar nature, these works needs to be studied to ascertain the existing information on the issue.

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The information gathered from the existing literature helped in determining the scope for this research.

2.2 HEALTH AND SAFETY MANAGEMENT IN CONSTRUCTION

Health and safety management refers to the tangible practices, responsibility and performance related to Health and Safety, including the association between Health and Safety (H&S) management, climate and culture. H&S climate is perceived to be the precise indicator of overall H&S culture, while H&S management practices reflect the H&S culture of upper management.

Consequently, good H&S management practices are reflected in the enhanced H&S climate of all employees (Mearns et al., 2003). According to Azimah et al., (2009), H&S management will not only resolve H&S challenges, but also enhance overall legal compliance. However, legislation by itself is inadequate to address the problems of managing workplace H&S.

2.2.1 Health And Safety Management Systems

The construction industry seems to suffer from a general inability to manage workplace health and safety to a level where an achieved improvement in safety performance by a way of pro-active measures can result in zero accidents. Health and safety management in developing countries is based on the existence of regulatory frameworks requiring workplaces to be safe and

institutional structures to enforce the law. Employers are required to ensure their workplaces are free of hazards injurious to the health of their workers and other persons whose health may be adversely affected by the operations of the business.

According to Krause (1993) incidents occur downstream of culture (purpose, mission, values, goals, assumptions), management system (accountability, attitude, training, education, resources) and exposure (behaviour, conditions, plant, equipment). Krause maintains that employee behaviour is a direct result of management system and is the final common pathway of most incidents. Management system in turn is influenced by the organisation culture which has a substantial influence on, inter alia, priorities and the allocation of resources to health and safety effort.

Therefore, construction site safety culture is viewed herein as a reflection of the three elements identified by Krause, as adopted and promoted by the management of contracting organisations to directly or indirectly enhance the safety of individuals on the job site. This definition is adopted as the process of site safety is usually managed reactively and is the sole responsibility of the contracting organization (Hinze and Wiegand, 1992).

2.2.2 Construction Health And Safety Responsibilities

Construction health and safety should be of primary concern to employers, employees, governments and project participants (Kheni, 2008). Thus the main parties responsible for construction health and safety are the client, main contractor, regulatory agencies and employees.

Employers in developing countries have the responsibility for taking measures to control health and safety risks at work. This has however proved a daunting task for many employers,

particularly in owner/managers of construction. Apart from the fact that the peculiar characteristics of the industry makes the risks of accidents and ill-health very high, the organization of work and physical conditions in developing countries heighten the health and safety problems.

On construction sites specifically supervisors / foremen are the most conspicuous leaders and are perceived by the workforce as visible 'face' of the company. It is leaders with authority and ability who are able to influence the desired behaviours necessary for a safe environment by reinforcement of the organisation's safety values. Wentz (1998) argues that management should encourage and support safety by setting a good safety example; effectively managing health and safety programmes, attending health and safety meetings, performing inspections, investigating near-miss accidents and reviewing safety performance at all levels

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Table 2.1: Roles of parties in ensuring health and safety in construction

Parties	Roles
Client	Appoint the right people Allow adequate time Provide information to building team Ensure that team communicates and co-operates Ensure suitable management arrangements are in place. Ensure adequate welfare facilities are on site Ensure workplaces are designed correctly Appoint a principal contractor Ensure a health and safety plan is in place Keep the health and safety file Protecting the public
Regulatory agencies	Guidance notes Safety alerts Health and safety education Enforcement Health and safety law
Employee	Wearing of PPE Take care of equipment Report any defects
Contractor	Provide safe access on site Working at height safety precautions Safe scaffolds Safe excavations Safe ladders Safe loading and unloading of goods Safe traffic, vehicles and plant Safe tools and machinery Safe hoists and cranes Safe emergency procedures Safe storage, handling and disposal of hazardous substances Protecting the public

Source: HSE (2003)

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2.2.3 Causes of accidents in construction

Many reasons have been advanced for the causes of accidents. Various theories have also been promoted for these reasons. In the UK a research was commissioned into construction health and safety practices to ascertain the underlying causes of construction fatal accidents in the UK (Brace et al., 2009). The underlying causes of construction accidents identified were categorised under societal and industry-wide influences (macro); project and process factors (mezzo) and worker/supervisor/workplace causes (micro). The causes of construction accidents at the macro level were identified to include immature corporate systems, inappropriate enforcement, lack of proper accident data, lack of leadership from 'Government' as a key client and a lack of influence of trades unions in practice on most sites, especially for smaller projects.. These factors were also exacerbated by poor behaviour, cost pressures; poor equipment or misuse of equipment, including personal protective equipment; site hazards; poor employment practices; an itinerant workforce and inadequate management of and provision for vulnerable workers such as younger, older or migrant workers (Brace et al., 2009).

2.2.4 Factors affecting Safety on Site

Bottani et al., (2009) linked human performance with safety. Studies have agreed with this assertion (Jacobs and Haber, 1994). Human errors are one of the major underlying causes of industrial accidents, and the core component of various safety problems in high risk facilities (Jacobs and Haber, 1994). Various theories have been propounded for this. For example Hinze's (1996) Distraction Theory states that workers who are distracted by physical hazards or mental diversions are at increased risk of accidents. Another school of thought has established the Accident Causation Theory, which pinpoints the importance of error identification in accident prevention (Suraji et al., 2001). Mitropoulos and Cupido (2009) also suggest that production practices can prevent production errors. Therefore, it is asserted that safety practices can prevent

human errors and thus reduce the likelihood of accidents if these practices are shaped by the guiding principle and focusing on avoiding construction errors and rework.

Although accidents caused by the uncertain environment may not be easily avoided, it is however possible to regulate and improve current safety management to safeguard workers from artificial work related hazards by instilling positive employee behaviour (e.g., avoidance of premature acts, awareness of safety work) driven by an effective management system (Krause, 1993).

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2.2.5 Overview on Safety Climate

In recent years there has been a movement away from safety measures purely based on retrospective data or `lagging indicators' such as fatalities, lost time accident rates and incidents, towards so called `leading indicators' such as safety audits or measurements of safety climate. The shift of focus has been driven by the awareness that organisational, managerial and human factors rather than purely technical failures are prime causes of accidents in high reliability industries (Weick et al., 1999).

Safety climate, as defined in the literature, refers to a coherent set of perceptions and expectations that workers have regarding safety in their organization (Zohar, 2000; Cooper & Phillips, 2004; Silva et.al. 2004).Safety climate can be regarded as the surface features of the safety culture discerned from the workforce's attitudes and perceptions at a given point in time (Cox and Flin, 1998;). It is a snapshot of the state of safety providing an indicator of the underlying safety culture of a work group, plant or organisation. This concept is to be effectively translated into an operational measure for safety management of the construction industry.

In a study conducted within Australian construction industry, Mohamed, (2002) used structural equation modelling to investigate the independent factors that accounted for safety climate and

the relationship of climate to safety outcomes. Amongst other findings he found evidence that organisational climate predicts safety climate, safety climate influences both safety knowledge and safety motivation, and that safety knowledge and safety motivation predict safety compliance and safety participation. In short, a positive safety climate was significantly associated with observed safe work behaviour.

Mohamed's study demonstrated that safety climate is related to general organizational climate, that interventions designed to improve general organisational climate may have a positive impact on safety climate, that a specific climate for safety is more strongly related to safety performance than the general climate of an organisation, and if improvements in safety climate are to have any impact of safety performance, then they must first produce changes in knowledge or employee motivation.

Similar to Mohamed's 2002 study, this study found organisational climate predicted safety climate, and safety knowledge and safety motivation predicted safety compliance and participation. These are important corroborative findings and demonstrate the generalizability across industries of the links between organisational climate, safety climate and safety performance.

2.3 SAFETY MANAGEMENT

Safety management is a method of manipulating on-site safety policies, procedures, and practices relating to a construction project (Wilson and Koehn, 2000). This is a dynamic process accommodating small or large adjustments made to site operations in order for workers to work properly without facing unexpected disruptions to a construction project. Emphasis is placed on how accidents in a project can be reduced by effective safety management (Suraji et al., 2001).

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The enhancement of safety performance, improves the performance of many companies (Jaselskis et al., 1996).

Despite the fact that safety management system has been found to improve safety performance, most construction projects do not establish such a system on site (Bottani et al., 2009;). Häkkinen (1995) showed that a lack of commitment to safety management may lead to reduced safety awareness.

The degree to which a project is finished successfully depends to the extent to which the project is managed. Thus, safety management has become an integral part of project management. However, recent construction safety research has been undertaken to mainly study the effect of factors on safety performance (e.g., Abudayyeh et al., 2006, El-Mashaleh et al., 2010, Yung, 2009; and Zou and Zhang, 2009), explore the role of different parties, such as designers and owners, on site safety (e.g., Huang and Hinze, 2006 and Seo and Choi, 2008), and examine the effectiveness of safety programs. In the study by Fernández-Muñiz et al; (2009), a safety management system that comprises elements of policy, incentives, training, communication, control, and planning was found to be significantly related to safety, competitiveness, and economic- financial performance. This brings to light the focus of this research. Construction Extension Guide to the Project Management Body of Knowledge (PMI,2007) illustrates tools that are requisite for the management of safety in project management. Figure 2.1 shows an overview of the project safety management. The figures show three main aspects of the project safety management; safety planning, safety assurance and safety control. As stated earlier this research focuses on the use of safety assurance tools. The tools are discussed in the ensuing sections.

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2.4 TOOLS AND TECHNIQUES FOR SAFETY ASSURANCE

2.4.1 Safety Planning Tools and Techniques

Safety planning is classified as a tool in the PMBOK Guide (PMI, 2007). Safety planning involves determining how to approach, plan and execute the requirements for project safety management.

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Figure 0.1. Project Safety Management Overview

PROJECT SAFETY MANAGEMENT

Safety Planning

Inputs:

1. Enterprise environmental factors
2. Organizational process assets
3. Project scope statement
4. Project management plan
5. Contract requirements
6. Safety legislation
7. Project stakeholder requirements
8. Safety policy
9. Perform safety assurance measurement
10. Site neighborhood characteristic and constraints

Tool s and Techniques:

1. Cost benefit analysis
2. Benchmarking
3. Trials and simulations
4. Cost of Safety
5. Additional safety planning tools
6. Process mapping
7. Flowcharting
8. Project Safety requirements review
9. Risk management processes tools and techniques

Outputs:

1. Safety management plan
2. Safety metrics
3. Safety checklists
4. Process improvement plan
5. Safety baseline
6. Project management plan
7. Safety zoning and signage
8. Safety training and induction requirements
9. Traffic management plan
10. Safety emergency response plan
11. Permit to work management plan

Perform Safety Assurance

Inputs:

1. Safety Management Plan
2. Safety Metrics
3. Process Improvement Plan
4. Work Performance Information
5. Approved change requests
6. Safety control measurements
7. Implemented change requests
8. Implemented corrective action
9. Implemented defect repairs
10. Implemented preventive actions
11. Organizational process assets
12. Contract requirements

Tools and Techniques:

1. Safety planning tools and techniques
2. Safety audits
3. Safety hazard risk analysis
4. Process analysis
5. Perform safety control tools and techniques
6. Safety management process
7. Risk management processes tools and techniques

Outputs:

1. Request charges
2. Recommend corrective actions
3. Organizational process assets
4. Project management plan
5. Perform safety assurance measurements
6. Safety management plan
7. Process improvement plan
8. Safety monitoring and control plan

: Perform Safety Control

Inputs

1. Safety management plan
2. Safety metrics
3. Safety Checklists
4. Organizational process assets
5. Work Performance Information
6. Approved change requests
7. Deliverables

Tools and Techniques:

1. Safety hazard risk analyses
2. Accident Investigation
3. Process statistical analyses and reporting methods
4. Perform safety planning tools and techniques
5. Perform safety assurance tools and techniques
6. Statistical sampling and testing
7. Inspection
8. Defect repair review
9. Process mapping
10. Flow charting
11. Risk management tools and techniques

Outputs:

1. Safety control measurements
2. Validated defect repair
3. Safety baseline
4. Recommended corrective action
5. Recommended preventive action
6. Requested charges
7. Organizational process assets
8. Validated deliverables
9. Project management plan
10. Project safety management plan
11. Safety monitoring and control plan
12. Non-conformance reports and rework

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In construction, it is estimated that about 90 per cent of accidents could be prevented through better planning before work starts (HSE, 1988). More recent studies have found that planning and control failures were related to 45.4 per cent of accidents (Duff and Suraji, 2000), and designers could have contributed to the prevention of up to 47 per cent of accidents investigated as part of an HSE research project (HSE, 2003). Effective planning for Health and Safety (H&S) is therefore essential if projects are to be delivered on time, without cost overrun, and without experiencing accidents or damaging the environment or the health of site personnel (Teo et al., 2005).

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The PMBOK guide defines practices for safety planning to include determining the applicable requirements which define the critieria that will be employed to determine both the suitability of a project management system in fulfilling the requirements of the project and the ultimate acceptance of the product or project. The guide also adds assessing how best to apply the applicable acceptance criteria, documenting their characteristics and associated risks, and determining how to satisfy them (PMI, 2007). Lastly determining how the suitability and effectiveness of project safety management will be assessed or determined (PMI, 2007). The contract for any construction work involve is the principle project safety standard, as it will specify the applicable safety statutory and legislative requirements, technical safety codes, standards and regulations. Safety planning tools include Cost benefit analyses, benchmarking, trials and simulations, cost of safety (COS), additional safety planning tools, process mapping, flowcharting, project safety requirements review and risk management processes tools and techniques (PMI, 2007).

2.4.2 Safety Audits

Audits involve undertaking the structured and independent reviews to ensure that project activities of the performing organizations comply with the project. A safety audit is a planned process of gathering independent information on efficiency, effectiveness and reliability of the total safety management system and draw up plans for correct action (Teo, 2007)

2.4.3 Safety Hazard Risk Analysis

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Safety hazard risk analyses are systematic reviews of each construction process, activity or work element to identify the potential safety hazards for project personnel as well as other who are present on the site associated with the activity or process. These analyses are normally carried out by specific and knowledgeable members of the project management team of the performing organization with the assistance of key construction supervisors and are part of the risk identification process. Presence of hazard is the root cause of accident leading to human, economic, societal, and environmental losses. Identification of hazards is the first step in assessing risk of injury. Hazard identification includes identification of hazardous energy sources (for example, fuels, pressure containers, rotating machinery) and identification of hazardous processes and situations (for example, oxidation, radiation, rapid pressure changes, mechanical shocks) in a work system. Two approaches are common in hazard identification (Kumamoto and Henley, 1996): (i) a general engineering evaluation based on previous data and operational history (an informal approach), and (ii) a formal approach using well-developed hazard identification techniques. The approaches towards hazard identification can be further divided in three categories (Willquist and Torner, 2003): *Biased reactive approach*, where information is analyzed after occurrence of an accident event. This is typically an informal approach, and general engineering evaluations fall under this category. *Biased proactive approach*, where identification of hazards and failure modes are based on information from similar systems or

historic data from the same system. This is a formal approach towards hazard identification, and backward and forward tracking methods fall under this category. *Unbiased proactive approach*, where hazard analysis is carried out without waiting for the events to occur, and without any restrictive assumptions about presence of specific hazards in the work system. This is also a formal approach and morphological methods fall under this category. In these methods, the search is focused on potentially hazardous elements (like energy concentrations and hazardous materials), and potential targets (i.e. persons or equipment). Critical or significant factors influencing safety are focused while searching for hazards. Biased proactive methods depend heavily on available previous knowledge of the system. Even unbiased proactive methods are not completely unbiased, as previous experience is valuable in morphological hazard identification.

2.4.4 Process Analysis

Process analysis comprises root cause analysis, a specific techniques to analyze a problem/situation, determine the underlying causes that lead to it, and create preventive actions for similar problems (PMI, 2007). This follows the steps outlined in the process improvement plan to identify needed improvements from an organizational and technical standpoint. This analysis also examines problems experienced, constraints experienced and non-value-added activities identified during process operation (PMI, 2007).

2.4.5 Perform Safety Control Tools and Techniques

Safety control is a person's perception of the ability or opportunity to manage work situations to avoid injuries and accidents (Anderson et al., 2004). Previous research has show a high level of correlation of job control with health and well-being (Glass and McKnight, 1996), and with job satisfaction and motivation. This is further confirmed by the study of Spector who found that employees' perceptions of control play an important role in employees' occupational stress, health, and well-being (Spector, 1998). Research findings suggest that an increase in control

over safety-related elements in the work environment may lead to fewer injuries on the job. In the present study, the following hypothesis is proposed. Formal identification of hazards in the workplace is one of the foundations of successful safety management (Carter & Smith, 2006). However, the findings of Carter and Smith (2006) indicate that current hazard identification levels in construction projects are far from ideal. Some earlier studies have indicated that safety planning and control methods need to be improved even beyond what is required by regulations and standards (Saurin, Formoso, & Guimaraes, 2004).

Research conducted by Behm, 2005 and Gambatese et al., 2008 demonstrated that 42.0% of construction fatalities were linked to the design of the construction safety concept.

In recent years, academics and professionals have focused on the concept of Construction Hazards Prevention through Design, in which engineers and architects explicitly consider, during the design process, the safety of construction workers (Toole & Gambatese, 2008).

The PMBOK Guide provides that safety control involves determining and applying measure for monitoring the achievement of specific project results throughout the project to determine whether they comply with the safety requirements (PMI, 2007). Identifying unsatisfactory performance and identifying ways to eliminate causes of unsatisfactory safety performance. This includes failures on the part of safety planning and safety assurance.

2.4.6 Safety Management Processes

The PMBOK guide averts that safety management processes are detailed as part of management reviews (PMI, 2007). They provide an assessment and evaluation of the effectiveness and suitability of the project management system as a whole or in part by the performing organization's top management. Results of quality management reviews are used to effect changes and improvements to those elements of the project management systems that are not performing satisfactorily.

2.4.7 Risk Management Processes

Risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses and monitoring and control on a project; most of these processes are updated throughout the project. Risk assessment involves identifying potential threats, estimating their likelihood, and estimating the consequences. The combination of these estimates represents the risk associated with the activity being evaluated.. Occupational injury risk is the likelihood of getting injured while performing a particular job. Phases in assessment of injury risk include identification of hazards, evaluation of risk, and categorization of hazards based on risk index (Maiti, 2003).

Risk assessment methodologies are classified as: (i) qualitative methods, and (ii) quantitative methods (Tixier et al., 2002). These categories can further be classified as deterministic, probabilistic, and combinatorial approaches. Quantitative risk assessment requires the estimation of frequency and consequence severity in quantitative terms. This approach is suitable when the risks are high, costs of detailed analyses are justified, and relevant data is available. The results are represented in the form of risk profiles. Qualitative risk assessment is more suitable when risks are low and small number of categories can cover entire range of consequences and likelihoods. The results are represented in the form of risk matrices where occurrence probability and consequence severity represent the two axes. Risk assessment process includes two decisions: (i) selection of criterion variables, and (ii) selection of modeling techniques. The main objective of risk management are to increase the probability and impact of positive events and decrease the probability and impact of events adverse to the project. Risk management can be classified under 6 main divisions; risk management planning, quantitative risk analysis, risk identification, risk response planning, qualitative risk analysis and risk monitoring and control.

2.5 THE GHANAIAN CONSTRUCTION INDUSTRY AND SAFETY

In Ghana, the construction industry accounts for the highest rate of occupational deaths compared with other industrial sectors. According to the Labour Department (2000), out of a total of 902 occupational accidents that occurred in construction in the year 2000, 56 were fatal, a fatality rate of 77.6 per 100 000 workers. (Hämäläinen et al. (2006) averred that accident rates in developing economies are unacceptably high and it is predicted that the numbers will increase in parallel with the pace of industrialization. The study by Kheni (2008) on health and safety practices among construction SMEs in Ghana revealed serious problems. The main problems identified by Kheni included lack of skilled human resources, inadequate government support for regulatory institutions and inefficiency in institutional frameworks responsible for health and safety standards. Another problem highlighted was the significance of the Ghanaian socio-cultural value systems particularly, the extended family system and traditional religious value systems in health and safety management within Ghanaian construction SMEs. The research also provided insights into difficulties posed by the internal environment of SMEs to the effective management of health and safety. Kheni (2008) provides a broad understanding of health and safety in the construction sector in Ghana. Laryea (2010) also studied the state of health and safety on construction sites in Ghana. They used first hand observation of fourteen (14) construction project sites in 2009 and 2010. The results reveal a poor state of health and safety on Ghanaian construction sites. The primary reasons are a lack of strong institutional framework for governing construction activities and poor enforcement of health and safety policies and procedures. Confirming the previous study by Kheni (2008). Laryea also revealed that the Ghanaian society does not place a high premium on health and safety of construction workers onsite. Interviews with workers indicated that injuries and accidents are common on sites. These

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factors combine to make the construction industry in developing countries unsafe. The need for this study is brought into sharp focus.

2.6 CONCLUSION

This chapter explored pertinent literature related to the field of safety management and assurance in construction. Through the literature review seven tools were identified as safety assurance tool and techniques. The study also explored the state of safety construction research in the Ghanaian context.

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CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

In order to achieve the research aim and objectives appropriate methods were adopted for the study. This chapter presents a detailed explanation underpinning the choice of the research methodology for the study. Research strategy adopted for the study is highlighted as well as the research design. Also, the chapter defines the sampling technique and the characteristics of the sample. The statistical tools adopted for the data analysis are accordingly introduced in this chapter.

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3.2 RESEARCH STRATEGY, DESIGN AND PROCESS

Research strategy is central to the conduct of research; and accordingly the theory underpinning the choice of the direction of the researcher towards the conduct of research is very important (Baiden, 2006). Studies by Taylor-Powell (1998) defined research strategy as a probe into the research objectives. Broadly speaking there are three main forms of research strategy – quantitative, qualitative and mixed approach i.e. triangulation. Quantitative research has been described by a lot of authors to be involved with numbers. Quantitative research methods encompass observation, pilot studies, quantitative analysis and questionnaires. Qualitative research, on the other hand, involves methods that generate words rather than numbers in the data analysis (Patton and Cochran, 2002). Whist the mixed approach combines the advantages of the two techniques. The decision or the choice to follow any of these strategies is inextricably linked to the purpose of the study, the type and availability of research information (Baiden, 2006) and the research questions (Patton and Cochran, 2002). However, given the nature of the

research questions in this study, a quantitative approach to research was seen as the best approach to addressing the research questions/objectives.

Research design, on the other hand, is considered as the methodological 'blueprint' for the conduct of the research and it includes the methods and tools involved in the quantitative or qualitative research. Through a careful consideration, the decision was to use a survey to highlight more on the ways of improving safety assurance practices of contractors. According to Janes (1999), the only available way of getting the current picture of a group, profession, organisation, etc. is a survey. Consequently, Cresswell (2005) cited in Ayyash et al. (2011) argues that survey helps to provide trends in the population.

Whilst research process deals with data collection instruments, methods, and procedures. The study utilised questionnaire in eliciting views from the sample (primary data). The conclusion to use survey questionnaire was also because it is less expensive and not time consuming to conduct (Ayyash et al., 2011).

3.3 RESEARCH POPULATION AND SAMPLE SIZE

Population in research methodology is understood to be objects, phenomena, cases, events or activities specified for the purpose of sampling (Brynard and Hanekom, 2005). Thus, population consists of all the subjects under study. Sample, on the other hand, is defined as using a part to represent the whole (Taylor-Powell, 1998). It also refers to a subset within the population selected to participate in the study.

3.3.1 Population

The research population for this study comprised building contractors in the building construction industry. Eligibility describes the characteristics that subjects in the population must possess in order to be included in the study. To this end, only D1 and D2 building contractors working in the Ashanti region were considered. The reason being that the crux of the study was to emphasize on the usage and level of knowledge of safety assurance tools and techniques by building contractors. The ministry of works and housing provide a total number of 60 contractors working as D1 and D2 contractors in the Ashanti Region. This total number comprised the research population.

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3.3.2 Sampling Technique and Sample size

The procedure of selecting a subset to represent a whole population is termed as sampling (Taylor-Powell, 1998). Various techniques abound for the selection. However, in broad terms the techniques fall under Probability and Non-Probability sampling. Probability sampling gives every subject the opportunity to be included in the study; whiles non-probability sampling implies that not every element has the opportunity to be included (Mbokane, 2009). Due to the small population size, the total number of population was used by applying a simple random sampling to select the respondents. In this study sixty D1 and D2 building contractors in the Kumasi Metropolis which made up the whole population was used. The respondents of the companies included Project Managers, Site Engineer, Health and Safety Officers.

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3.4 DATA COLLECTION

Data is defined as information gathered in the course of the study. Questionnaire was used in order to capture data relevant to the objective and research questions of the study. The purpose of the study is to improve safety assurance practices of contractors in Ghana.

3.5 SOURCES OF DATA

A variety of information sources exist from which to gather data. The kind of source chosen depends on the information available and what provides answers to the research questions (Taylor-Powell and Steele, 1996). Primarily, there are two sources of data – primary and secondary. Primary data are information that the researcher collects because no one has compiled and published for public accessibility (Thomas, 2010). Neville (2007) argued that every research must include empirical research data (i.e. primary data). To this end, the primary data sources are construction professionals in the Building construction industry.

Secondary data made up of relevant literature about construction health safety and the seven basic safety assurance tools and techniques.

3.6 DATA COLLECTION INSTRUMENTS

The literature review revealed seven safety assurance tools and techniques. The questionnaire was thus formulated in order to help elucidate on safety assurance tools and consequently through that help professionals improve safety assurance of contractors. In designing the questionnaire, two principal objectives guided the researcher. That is, first, to maximise the number of respondents; and second to obtain accurate relevant information for the survey (see Leung, 2001). With this the questionnaire was structured to have the following sections:

- Section A: Questions pertaining to the demographic data of the respond

- Section B: Questions related to the understanding and the level of knowledge of the seven safety assurance tools
- Section C: This section also dealt with the level of practice or usage of the seven safety assurance tools
- Section D: Related to ways of improving safety assurance among building contractors.

Rapport was established with the respondents just to increase their level of participation in the study. It has been observed that voluminous questionnaire most often tend to scare away respondents. Hence the length of the questionnaire was carefully designed to ensure maximum participation whilst not missing the broader picture of the study. To elicit accurate data, the questionnaire was close ended with respondents given the options to rate the identified tools and techniques on a four point and five point Likert scale. Close-ended questions allows for easy coding and easy analysis (Leung, 2001). Generally, the questionnaire was on a seven-page A4 sheet and has been included in the appendix of this study.

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3.7 DATA PRESENTATION AND ANALYSIS

The retrieved questionnaires were coded and analysed using simple statistical tools such as the Statistical Package for Social Sciences (SPSS) version 20.00 and Microsoft Excel. Demographic data was analysed using descriptive statistics. The use of relative index and mean score rankings was also utilised in the analysis of the data. The data obtained was presented graphically and in tabular form. Discussion of the research results was done in relation with previous study findings.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION OF RESULTS

4.1 INTRODUCTION

This chapter centres on the analysis of the primary data collected from the sixty (60) building construction participants (professionals, artisans, etc.) in the Kumasi Metropolis. Respondents were purposively sampled from various building construction companies in the aforementioned metropolis. This chapter deals with the analysis and discussion of the data collected to explore the level of knowledge and usage of safety assurance tools and techniques by building contractors in Ghana using sampled data from Kumasi.

The analysis is pivoted around the objectives of the study, that is, to examine the level of knowledge about the seven safety assurance tools and techniques, to identify the level of usage of the aforementioned safety assurance tools in their operations and to explore measures to improving safety assurance. This chapter also presents the results of the analysis and discussions in the form of texts, figures and Tables. The chapter is organized as follows; Background information of Respondents. Out of the sixty (60) questionnaires administered, fifty-three (53) were completed and returned representing 88.3%. The analysis was based on the 88.3% questionnaires completed and returned. The high response rate of 88.3% can be attributed to the fact that questionnaires were administered via online and in person and successive follow-ups thereafter. When the questionnaire were issued to the respondents in person, the respondents were encouraged to fill it right away.

4.2 BACKGROUND INFORMATION

This section presents background information on respondents such as the Classification of company, level of educational qualification and professional qualification, job position, years in

practice amongst others. Such analyses are imperative because the background of the respondents helps generate confidence in the reliability of data collected; and eventually the findings of the study.

4.2.1 Classification of Company

The study was limited to D1K1 and D2K2 contractors in the Kumasi Metropolis. The intention was that these contractor classifications have the capacity to undertake complex projects involving more complex safety issues. Thus their input in improving the safety assurance in the building construction industry was of paramount essence.

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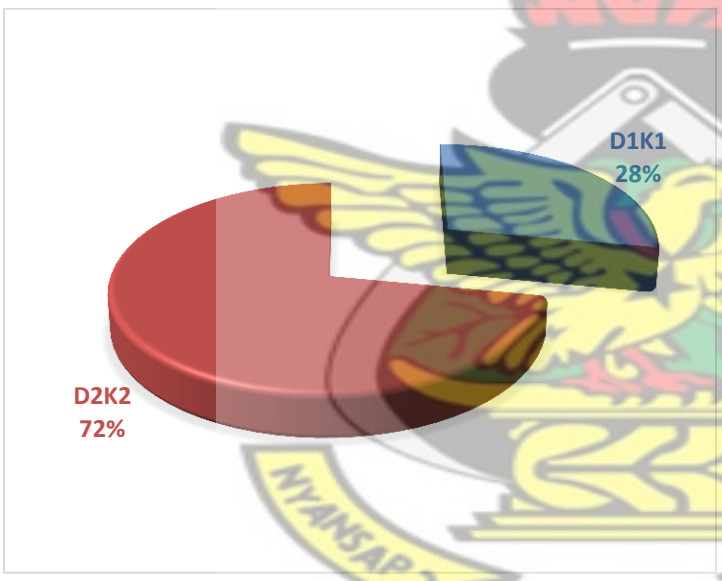

Figure 4.1. Classification of company

Out of the 53 responded questionnaires, a total number of thirty-eight (38) representing 72% respondents were of D2K2 firms whiles fifteen (15) number of the respondents representing 28% were of firms with D1K1 classification (see Fig. 4.1).

4.2.2 Educational Qualification

The question was posed to find the educational qualification of the respondents and since the level of this qualification to a larger extent determines a position in the firm and hence their involvement in construction decision such as issues on health and safety policies. Such involvements determine the quality of responses given. A cursory look at Figure 4. 2 reveals that 13 are Postgraduate holders, 16 First degree holders, 14 HND/Diploma holders and 10 have certificates (Technician). The deduction from the above statistics is that most of the respondents have higher degrees; hence their involvement in construction decision is most likely.

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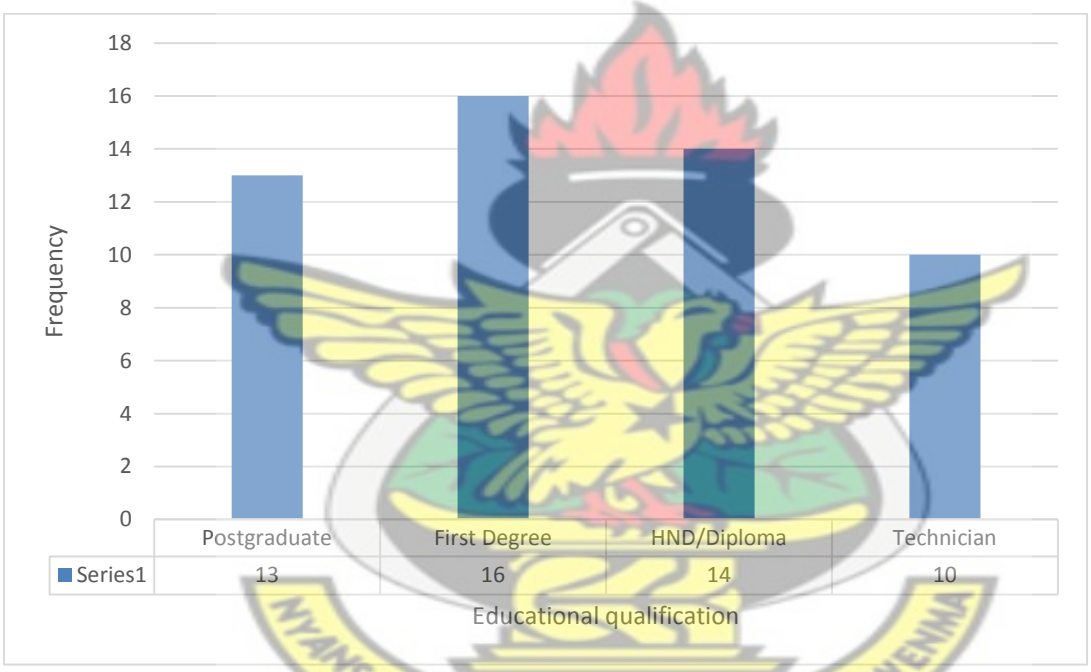

Figure 4.2 Level of Educational Qualification

4.2.3 Professional Body

Being a member of a professional body does not only instil trust in clients, members also benefit from Continuous Professional Development (CPD). These successive seminars and workshops organised by the professional bodies aim at improving the professional practice of members through teaching and learning of new techniques in the discipline. More so, the code of practice

and conduct streamlines the practice of the members further enforcing members to adopt the right practices. Depending on the discipline, several professional bodies exist. The attempt was to find the various professional bodies to which the respondents belong. Out of the 53 retrieved questionnaires, 45 respondents belonged to recognised bodies whereas 8 indicated non-membership (see figure 4.3.). A further examination of the 45 respondents that belonged to recognised bodies revealed the details below (figure 4.4). It can therefore be deduced that respondents with professional background were involved in the survey, thus the quality of their input is assured.

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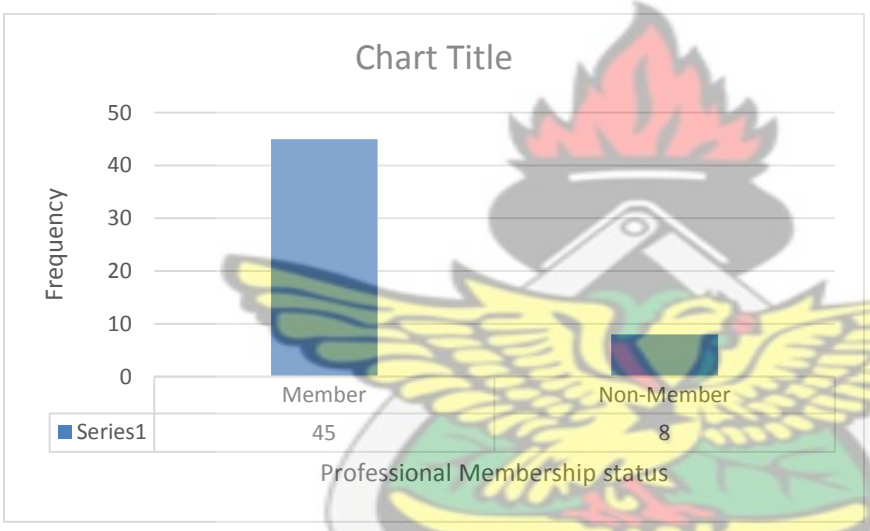

Figure 4.3 Professional Membership status.

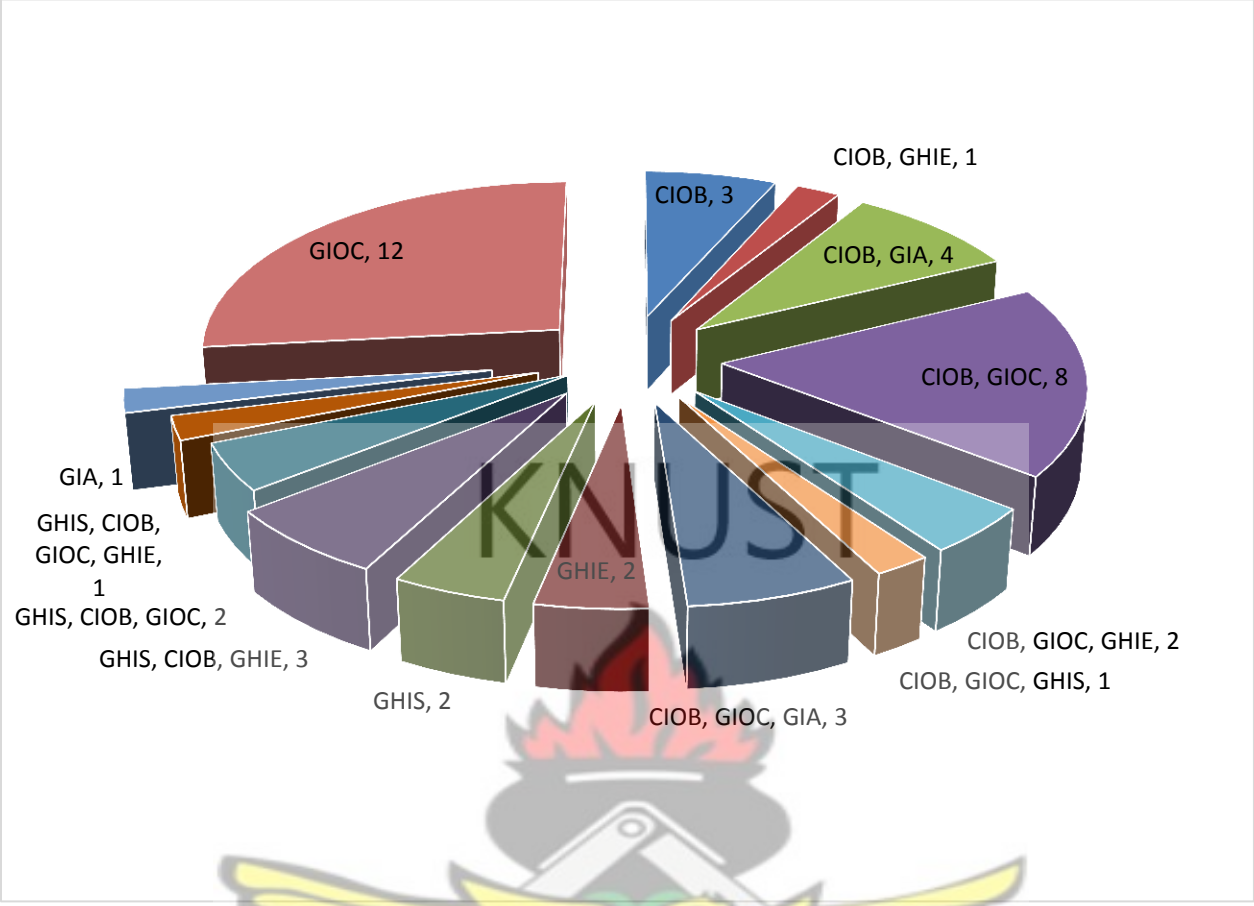

Figure 4.4 Level of professional body.

4.2.4 Job Position in the Company

The topic was hinged on two key components i.e. level of knowledge and usage. Job position, in one way or the other influences these components. In that, respondents in higher job positions usually implement company policies and every worker is expected to abide or observe the policies. So, the usage of the identified safety assurance and also ways of integrating them into company policies are heavily influenced by job position of the respondents. Consequently, respondents were asked to indicate their job positions in their respective companies. Figure 4.5 presents a breakdown of the analysis.

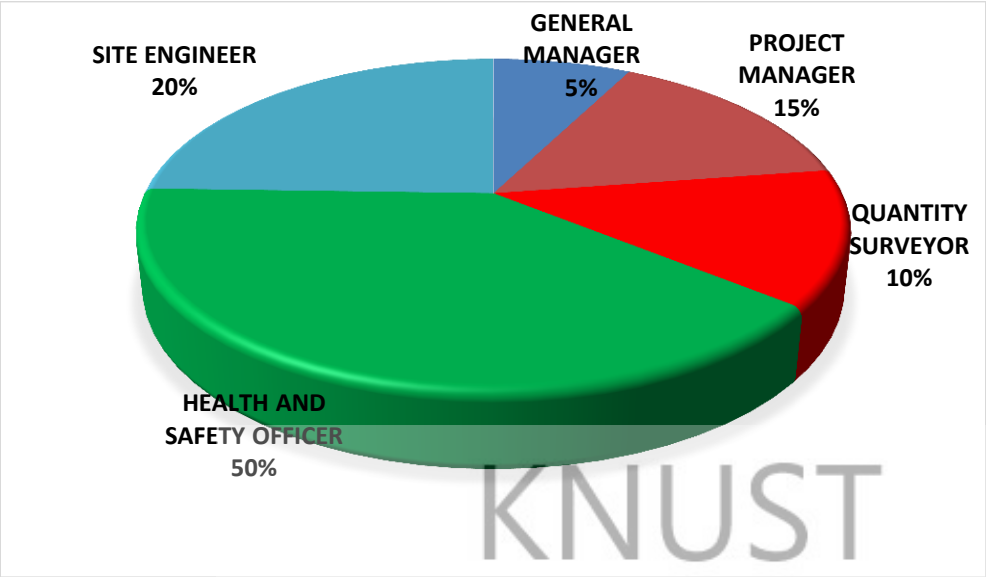

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Figure 4.5 Job Position in the Company.

4.2.5 Working experience and Length of Company existence

The main intent of this question was to ascertain working experience of respondents and also the length of operation of their respective companies. This information will give relevance to the quality of answers given out by the respondents since it is more likely to have engaged in a number of projects with different approaches to health and safety issues. Hence, this rich experience is imperative in the filling of the questionnaires. Tables 4.1 and 4.2 present the analysis on the length of company existence and working experience respectively.

Apparently, majority of the companies surveyed have been in existence for over five years representing 96.2% (35.8+43.4+15.1+1.9) (refer to Table 4.1). Also, the respondents have relatively sufficient working experience to complete the data. Altogether, the kind and quality of the information given is assured to be relevant to addressing the research questions.

Table 4.1 Length of company existence.

Years	Frequency	Valid Percent	Cumulative Percent
0-5 years	2	3.8	3.8
6-10 years	19	35.8	39.6
11-15 years	23	43.4	83.0
16-20 years	8	15.1	98.1
over 20 years	1	1.9	100.0
Total	53	100.0	

Source: Survey Data (2014)

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Table 4.2 Working Experience.

Years	Frequency	Valid Percent	Cumulative Percent
0-5 years	19	35.8	35.8
6-10 years	21	39.6	75.5
11-15 years	10	18.9	94.3
16-20 years	3	5.7	100.0
Total	53	100.0	

Source: Survey Data (2014)

4.2.6 Health and Safety issues

As part of the endeavour an attempt was made to establish if companies have departments or units in-charge of health and safety (H&S) and also if there exists a clear cut policy on health and safety in the company. Subsequently, respondents were asked to indicate by ticking a Yes or No. A cross-tabulation of the existence of H&S unit against H&S policy is performed. A cursory look at the Table 4.3 suggests that 29 companies have department of H&S and the remaining 24 have no such thing in their companies. Also, out of the 29 companies 26 have H&S policies whereas the remaining 3 do not have. Interestingly, out of the 24 companies that do not have H&S units 13 still have H&S policies. The department that oversees its implementation,

however, is a subject for discussion. Overall, there can be the conclusion that respondents have a fair idea of H&S.

Table 4.3 Cross tabulation of Department of H&S and H&S policy

		Department of Health and Safety in the company		
		Yes	No	Total
Health and Safety Policy	Yes	26	13	39
	No	3	11	14
Total		29	24	53

Source: Survey Data (2014)

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4.3 ANALYSIS OF DEPENDENT VARIABLES

Three statistical analyses were undertaken, namely relative importance index, mean score and standard deviation. The respondents were asked to rank the various safety assurance tools in terms of usage and level of knowledge using the Likert scale. Using the five-point Likert scale rating, a criterion is deemed significant if it had a mean of 3.5 or more and 2.8 if its based on the four-point likert scale. Where two or more criteria have the same mean, the one with the lowest standard deviation is assigned the highest significance ranking (Ahadzie, 2007). Standard deviation values of less than 1.0 indicate consistency in agreement among the respondents of the reported level of results (Ahadzie, 2007). They were altogether used to assess the various variables under the different sub-sections. The procedure, findings and relevant discussions are as follows.

4.3.1 Level of Knowledge of Safety Assurance Tools and Techniques

In an attempt to exploring the level of knowledge and usage of safety assurance tools and techniques, it deemed necessary and imperative to ascertain the level of knowledge of the seven

safety tools and techniques identified. In view of this seven techniques were identified from literature and respondents were asked to rate them according to their degree of knowledge on them on a four-point Likert scale items (Not at all, Limited, Working knowledge and Very Good Knowledge). Hence in establishing the level of knowledge, three different tools were adopted – RI, mean score and standard deviation.

From the analysis the respondents indicated that they had a higher level of knowledge of use of Risk management processes and tools more than any other tools. This was ranked 1st with a RII of 0.63. The study showed that the knowledge of process analysis was very poor. This had an RII of 2.09. The second most knowledgeable safety assurance tool was safety management processes which had an RII of 0.61. It has been already indicated a mean score of less than 2.8 shows that a criterion is not significant. From the analysis the highest mean score for the level of usage of safety assurance tools is 2.53. The standard deviation for this score is 0.75 which shows a lot of agreement with this assertion. The standard deviation for all the variables identified was below 1 showing a high degree of agreement within the respondents. These findings indicate a low level of awareness of safety assurance tools and techniques. The lack of awareness of these tools can be attributed to the high level of accidents on various sites in Ghana. Already a study by Kheni et al., (2008) found out that the Ghanaian construction industry accounts for the highest rate of occupational deaths compared with other industrial sectors (Kheni et al., 2008). This lack of awareness also resonates with a study conducted in Botswana which showed that most local contractors in developing countries especially Africa have a low level of awareness of safety (Musonda and Smallwood, 2008).

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Table 4.4 Level of Knowledge of Safety Assurance Tools and Techniques.

TOOLS AND TECHNIQUES	WEIGHTING	RI	RANK	MEAN	SD
Risk Management Processes Tools and Techniques	134.00	0.63	1	2.53	0.70
Safety Management Processes	130.00	0.61	2	2.46	0.80
Safety Planning Tools and Techniques	130.00	0.61	3	2.45	0.77
Perform Safety Control Tools And Techniques	127.00	0.60	4	2.40	0.66
Safety Hazard Risk Analysis	122.00	0.58	5	2.30	0.82
Safety Audits	119.00	0.56	6	2.25	0.83
Process Analysis	111.00	0.52	7	2.09	0.69

Source: Survey Data (2014)

4.3.2 Level of Usage of Safety Assurance Tools & Techniques

The next section explored the level of usage of the safety assurance tools and techniques. With the identified 7 safety assurance tools from the literature, the respondents were asked to rate using the Likert scale how often the safety assurance tools are used (1- Not at all, 2-Rarely, 3-Sometimes, 4-Most of the time, 5-All the time).

It is interesting to note that the survey results show the contractors use the perform safety control tools and techniques more than the risk management tools. In the earlier analysis risk management tools was rated 1st whilst perform safety control tools and techniques was rated 4th. However in this analysis perform safety control tools was ranked 1st followed by risk management tools and techniques. Process analysis was not rank last as in the earlier analysis but

rather 5th. The results show that safety audits and safety hazard risk analysis are hardly performed which both had an RI of 0.51. Again the results indicate that most of the safety assurance tools are not mainstream. Only one identified technique had a mean score above 2.80 which is perform safety controls tools. This indicates that safety assurance practices are on the low in most construction companies in Ghana. The level of agreement is very consistent as all the variables had a standard deviation of below one.

Table 4.5 Level of Usage of Safety Assurance Tools & Techniques.

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TOOLS AND TECHNIQUES	WEIGHTING	RI	RANK	MEAN	SD
Perform Safety Control Tools And Techniques	153	0.58	1	2.89	0.70
Risk Management Processes Tools And Techniques	145	0.55	2	2.74	0.71
Safety Management Processes	144	0.54	3	2.72	0.79
Safety Planning Tools And Techniques	140	0.53	4	2.64	0.74
Process Analysis	139	0.52	5	2.62	0.79
Safety Hazard Risk Analysis	135	0.51	6	2.55	0.70
Safety Audits	134	0.51	7	2.53	0.77

Source: Survey Data (2014)

4.3.3 Measures to Improve Safety Assurance

The next question explored measures to improve safety assurance. From the review of literature measures were identified and the respondents to the survey were ask to rate the level of agreement with these measures to help improve safety assurance. Eleven measures were

identified. The respondents were allowed to add more measures. However, none of the respondents added any other measures. The respondents did this on a four-point Likert scale. The highest ranked measure was "clearly defined goals and objectives" which had an RI of 0.44 and a mean of 1.75. The respondents showed that among all the measures," goals and objectives" is key in assuring safety assurance on site. The next highest ranked measure was good communications and feedback. This rating was the same as the first however the standard deviation was higher than the first. This shows that there is more agreement amongst the respondents on the measure "defined goals and objectives" than "communications and feedback". The third was incentives for safety. Incentives play a pivotal role in assuring safety assurance on site. The survey results show that the use of regular inspection and audits of site safety would not necessarily improve safety assurance. This measure had the lowest mean score (1.43) and the lowest RII (0.36). First of all the ratings from this survey were very poor. For all the measures identified, the highest mean score achieved was 1.43 (far lower than 2.8) and the highest RII was still lower than 0.50. It is worth noting that despite the fact that the respondents were asked to add their own measures none did and for the measures identified there was a consistent agreement that it was not significant. The researcher is of the view that, commitment of contractors to safety requirements is paramount for any of the measures identified to be significant. Due to the poor ratings given and the unwillingness for the respondents to come out with a significant measure a logical conclusion could be that the respondents are not committed to safety assurance on construction site. Also a look at the highest ranked measures, one can see that they border more on the commitment of key management.

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Table 4.6 Measures you would suggest to improving safety assurance.

TOOLS AND TECHNIQUE	WEIGHTING	RI	RANK	MEAN	SD
Clearly Defined Goals And Objectives	93	0.44	1	1.75	0.52
Good Communication And Feed Back	93	0.44	2	1.75	0.65
Incentives For Safety	91	0.43	3	1.75	0.63
Compliance To Safety Assurance Requirement	89	0.42	4	1.68	0.51
Well Defined Roles And Responsibilities	87	0.41	5	1.64	0.59
A Clear Policy On Safety Assurance	86	0.41	6	1.62	0.56
Process Improvement Guidelines And Strategies	86	0.41	6	1.62	0.56
Strict Management Commitment Safety	84	0.40	8	1.64	0.59
Employee Involvement- Frontline Workers Involvement In Decision Making On Product Quality	83	0.39	9	1.57	0.57
Training And Education Of The Work Force	82	0.39	9	1.55	0.54
Regular Inspections And Audits Of Site Safety	76	0.36	11	1.43	0.67

Source: Survey Data (2014)

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4.4 CONCLUSION

This chapter was devoted to the analysis and discussions of the results obtained from the questionnaire survey. It began with a brief discussion of the survey questionnaires and descriptive statistics of the results obtained from the field. The study adopted the use of relative importance index, mean score and standard deviation to analyse the results of the survey. The study showed that level of awareness and use of safety assurance tools is on the low

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CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

This study sought to explore the level of knowledge and usage of safety assurance tools and techniques by building contractors in Ghana. Review of literature led to the identification of seven safety assurance tools and techniques. Adopting the quantitative research approach, a questionnaire survey was employed to assess safety assurance tools used by contractors. The previous chapter analysed and discuss the results of the study. This chapter presents the findings of the study in relation to the laid out objectives of the study. Recommendations from the study are put forth. The study limitations and directions for future research are also presented

The objectives to the study include:

- To assess the level of knowledge of building contractors in Ghana on safety assurance tools and techniques
- To assess the level of usage of safety tools and techniques by building contractors in Ghana
- To identify practical measures to improve safety assurance by building contractors in Ghana

These research objectives served as guidelines in achieving the stated aim of the study. The research results are discussed in relation to the objectives of the study.

5.2 OVERREVIEW OF OBJECTIVES

The main aim of this research was to explore the level of knowledge and usage of safety assurance tools and techniques by building contractors in Ghana. Research objectives were subsequently developed in order to achieve the stated aim. Here, the research objectives are highlighted to the extent to which they were accomplished through the various phases of the research. The study employed the use of relative importance index, mean score and standard deviation in the analysis

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5.2.1 OBJECTIVE 1: To assess the level of knowledge of building contractors in Ghana on safety assurance tools and techniques

In an attempt to exploring the level of knowledge of safety assurance tools and techniques, the seven safety tools and techniques were identified from literature. From the analysis the highest mean score for the level of usage of safety assurance tools is 2.53. The standard deviation for all the variables identified was below 1 showing a high degree of agreement within the respondents. The findings indicate a low level of awareness of safety assurance tools and techniques. The lack of awareness of these tools can be attributed to the high level of accidents on various sites in Ghana.

5.2.2 OBJECTIVE 2: To assess the level of usage of safety tools and techniques by building contractors in Ghana

To achieve objective two the respondents were asked to rate using the Likert scale how often the safety assurance tools are used.. The findings show that only one identified technique had a mean score above 2.80 which is perform safety controls tools. The level of agreement amongst those surveyed showed a high level of consistency with none of the standard deviation below one. This

indicates that safety assurance practices are on the low in construction companies in Ghana. From the study it was concluded that most of the safety assurance tools are not mainstream.

5.2.3 OBJECTIVE 3: To identify practical measures to improve safety assurance by building contractors in Ghana

From the study of extant literature various measures were identified. The respondents to the survey were ask to rate the level of agreement with these measures to help improve safety assurance. Eleven measures were identified. The findings from the study showed that among all the measures "goals and objectives" is key in assuring safety assurance on site. The survey results showed that the use of regular inspection and audits of site safety would not necessarily improve safety assurance. Due to the poor mean scores achieved by the measures the study show that the respondents are not committed to safety assurance on construction.

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5.3 RECOMMENDATIONS

Safety is very paramount on the construction industry. With the Ghanaian construction industry performing very poor in regards to safety, the need to assure safety on construction site is not far fetched. The findings from the study informs on recommendations to be put forward. From the study the following recommendations are made:

- **Central development and regulatory agency**

The lack of existence of central development and regulatory agency in the construction industry has created an inability of safety being adhered in the construction. There is a need for a central agency with legislative authority to enforce the assurance of safety in the Ghanaian construction industry.

- **Role of clients and consultants in Safety Assurance**

Clients can play a pivotal role in ensuring safety on site. Most clients are however not concerned about safety as much as they are concerned about the quality and cost of the final product. Nevertheless, clients can act as great influencers in assuring safety on construction sites. The level of understanding of safety implications on projects and informed decisions on such will act as a first step in ensuring safety assurance on site. Consultants need to also provide the requisite information to clients in relation to safety issues and ensuring safety policies are adhered to on site.

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- **Role of enforcing agencies**

Government departments and agencies responsible for implementing health and safety standards on construction sites and other workplaces should provide a framework for monitoring and ensuring safety assurance on site

5.4 LIMITATIONS OF THE RESEARCH

Limitations stemming from the nature of the topic being investigated are acknowledged. In the first place the geographic focus of the study due to time constraints limited the study to only one region. This impacted the study population and the consequent sample size. The study also only focused on the level of knowledge of the tools and did not explore the dimensions and the extent of the knowledge of the tools. These aspects were beyond the scope of the study. The findings are a first step towards the use of safety assurance tools and techniques. The study findings were from only contractors and did not explore the views of consultants and clients.

5.5 DIRECTION FOR FUTURE RESEARCH

This study limitation exposes a number of areas, which need further research attention. The following recommendations are therefore made for future research:

- The study limitation of a smaller area should be widened to increase the applicability of the research findings.
- A study on measures to be adopted for the advancement of the use of safety assurance tools and looking how these measures impact the use of the tools.
- Future study should also focus on the dimensions and the extent of knowledge of the use of the tools.
- Each technique identified under the safety assurance tools need to be investigated in depth; exploring their impact on construction site, the level of usage and understanding of the tools.

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APPENDIX

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF ARCHITECTURE AND PLANNING

DEPARTMENT OF BUILDING TECHNOLOGY

MSc. CONSTRUCTION MANAGEMENT

QUESTIONAIRE

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The researcher is a post-graduate student at the Kwame Nkrumah University of Science and Technology studying for a Master of Science degree in Construction Management. The researcher is conducting a research into "EXPLORING THE LEVEL OF KNOWLEDGE AND USAGE OF SAFETY ASSURANCE TOOLS AND TECHNIQUES BY BUILDING CONTRACTORS IN GHANA". The aim of this research is to improve safety performance of contractors in Ghana.

This questionnaire is designed for academic work and will take about 10 minutes of your time to fill and that respondent's information provided will be treated as confidential as possible.

In case of any clarification please contact me **on 0244293201 or 0201342214 or email;glarnyoh@hotmail.com**. I will be very glad if you could sincerely answer the follow questions for me. Thank you.

SECTION A: BACKGROUND INFORMATION

1. Class of Company D1K1 ☐ D2K2 ☐

2. What is your highest level of educational qualification?

☐ Postgraduate ☐ First Degree ☐ HND/ Diploma

☐ Technician (CTC I, CTC II, CTC III)

3.What is your level of professional qualification?

GHIS ☐ CIOB ☐ GIOC ☐ GIA ☐ GHIE ☐

Etc……

……...

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4. What is your job position in the company?

☐ Managing Director ☐ Project Manager/Contract Manager

☐ Health and Safety Officer ☐ Site Engineer

☐ Others (specify)

4. How many years' experience do you have in the industry?

☐ 0-5 years ☐ 6-10 years ☐ 11-15years ☐ 16-20years ☐ Over 20years

5. How long has your company been in existence?

☐ 0-5 years ☐ 6-10 years ☐ 11-15 years ☐ 16-20years ☐ over 20years

7. Does your company have a Health and Safety Unit / Department? YES ☐ NO ☐

8. Does your company have a health and Safety Policy? YES ☐ NO ☐

SECTION B: LEVEL OF KNOWLEDGE OF SAFETY ASSURANCE TOOLS& TECHNIQUES

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Please express your level of Knowledge about the seven safety assurance tools& techniqueson a scale of 1-4

1-Not at all, 2- Limited, 3-Working Knowledge, 4–Very Good knowledge

Item	Tool& Technique	Ranking			
		1	2	3	4
1	**Safety Planning Tools and Techniques (**eg.Bench marking, Planned strategies adopted to mitigate accidents on sites, Flow charting, Trials and Simulations, Project Safety Requirements Review, etc.)	☐	☐	☐	☐
2	Safety Audits	☐	☐	☐	☐
3	Safety Hazard Risk Analysis	☐	☐	☐	☐
4	Process Analysis	☐	☐	☐	☐
5	Perform Safety Control Tools and Techniques(eg. Accident Investigation, Inspection, Defect Repair Review, Statistical Sampling and Testing, etc).	☐	☐	☐	☐
6	Safety Management Processes	☐	☐	☐	☐

7	Risk Management Processes Tools and Techniques(eg.the act of identifying, analysing and responding to risk).	☐	☐	☐	☐

SECTION C: LEVEL OF USAGE OF SAFETY ASSURANCE TOOLS& TECHNIQUES

Please indicate your level of usage of the seven safety assurance tools in your operations on a scale of 1- 5.

1- Not at all, 2-Rarely, 3-Sometimes, 4-Most of the time, 5-All the time

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Item	Tool& Technique	Ranking				
		1	2	3	4	5
1	Safety Planning Tools and Techniques	☐	☐	☐	☐	☐
2	Safety Audits	☐	☐	☐	☐	☐
3	Safety Hazard Risk Analysis	☐	☐	☐	☐	☐
4	Process Analysis	☐	☐	☐	☐	☐
5	Perform Safety Control Tools And Techniques	☐	☐	☐	☐	☐
6	Safety Management Processes	☐	☐	☐	☐	☐
7	Risk Management Processes Tools And Techniques	☐	☐	☐	☐	☐

SECTION D

Please indicate on a scale of 1-4measures you would suggest to improving safety assurance

1- Strongly agree, 2- Agree, 3- Disagree, 4 – Strongly disagree,

Item	Tool & Technique	Ranking			
		1	2	3	4
1	Employee involvement- Frontline workers involvement in decision making on product quality	☐	☐	☐	☐
2	Strict Management commitment to Safety	☐	☐	☐	☐
3	Training and education of the work force	☐	☐	☐	☐
4	Compliance to safety assurance requirements	☐	☐	☐	☐
5	Incentives for Safety	☐	☐	☐	☐
6	Clearly defined goals and objectives	☐	☐	☐	☐
7	Process improvement guidelines and strategies	☐	☐	☐	☐
8	Regular inspections and audits of site safety	☐	☐	☐	☐
9	Well-defined roles and responsibilities	☐	☐	☐	☐
10	A clear policy on safety assurance	☐	☐	☐	☐
11	Good communication and feed back	☐	☐	☐	☐

Any other recommendation on how safety assurance can be improved in the construction industry in Ghana

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Thank You!!!!!!

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