KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

COLLEGE OF ARCHITECTURE AND PLANNING

DEPARTMENT OF BUILDING TECHNOLOGY

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

A DISSERTATION SUBMITTED TO THE DEPARTMENT OF BUILDING TECHNOLOGY IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE MASTER OF SCIENCE IN CONSTRUCTION MANAGEMENT

BY

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DECLARATION

I hereby declare that this submission is my own work towards the award of an MSc and that to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of this University or other, except where due acknowledgement has been made in the text.

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DEDICATION

Giving reverence to the Almighty God for his abundant grace and mercy, I dedicate this work to my mother, wife and my children Richlove and Reynolds for their relentless prayer, gallant and twitchy contributions, moral support and encouragement to the success of my education. Worthy of mention here also, are all my lecturers who taught me in KNUST and fellow course mates whose contribution has resulted in the successful completion of this project.

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ABSTRACT

The construction industry has been recognized as one of the most hazardous industries in the economy. In recent times, health and safety continues to be a major challenge in the construction industry. With the use of safety control tools and techniques by building contractors, accidents can be significantly minimized and hence ensuring safety in the construction industry. The aim of this study is to explore the level of knowledge and usage of safety control tools and techniques by contractors in Ghana and to identify practical safety control measures required to improve safety in building construction sites in Ghana. The study utilized survey questionnaires designed using factors identified from review of extant literature on the topic and preliminary survey to elicit the perceptions on health and safety control tools and techniques from respondents. Descriptive statistics and relative important index was utilized for analyzing the data generated. The findings of the study revealed that majority of the surveyed respondents of the study have knowledge about the process statistical analysis and reporting methods employed in the construction industry. Moreover majority of the respondents also believe their respective construction companies seldom conduct safety hazard risk analysis. The use of flowcharting and statistical sampling and testing were top ranked among the safety control measures required to improve safety in building construction sites in Ghana. The findings of the study will be of use to construction professionals seeking innovative measures to improve health and safety on their construction sites. It is therefore recommended that the construction industry give keen attention to Health and Safety Control tools and techniques.

Keywords: Construction Industry, Health and Safety, Ghana, Measures, Contractors.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The construction industry has been recognized as one of the most hazardous industries to work in (Carter and Smith, 2001). Over the years, health and safety continues to be a major challenge in the construction industry. In the event of accident at a construction site, lives and properties are lost. In spite of these constraints facing the industry in developing countries, it makes significant contributions to economic growth.

A number of studies have highlighted the role the industry plays in the economy of developing countries (Anaman and Osei-Amponsah 2007). These studies have established significant relationships in one way or another, between the rate of growth of the construction industry and the rate of macroeconomic growth. Typically, the industry contributes 2 to 11 percent of GDP in most developing countries (Wells, 2001). The products of the industry are used by other industrial sectors for the production of other goods and services. For instance, the development of feeder roads of the construction industry in nation building, its activities sadly poses serious health risks to workers, users of construction facilities and the public. It has been acknowledged that 25–40 percent of fatalities in the world's occupational settings are contributed by construction (ILO, 2005). Other research conducted in developing countries corroborates evidence of this relatively high proportion of accidents on construction sites (Muric, 2007). The reasons why construction is risky and prone to health and safety risks 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).

In Ghana, the construction industry accounts for the highest rate of occupational deaths compared with other industrial sectors (Labour Department, 2000). According to Kheni et al., (2008) the rate of industrialization in developing countries require effective Occupational Health and safety (OHS) administrative systems to control hazards and to provide decent working environments that meet internal standards. Addo-Abedi (1999) advanced that the quality of working conditions need to be improved particularly for construction companies in developing countries. To this extent, not much has been achieved or done on the level of knowledge and the usage of safety control tools and techniques amongst Ghanaian building contractors. Hence the current study seeks to explore this knowledge gap.

1.2 STATEMENT OF THE PROBLEM

High rate of occupational accidents, particularly in construction means developing countries might be poor at managing the risks of hazards at workplaces. Hazards frequently encountered in the construction industry include: dangerous chemicals; dust; exposure to vibration; high noise levels; manual lifting of heavy weights; unguarded openings; ionizing radiations; fire; exposure to live cables; and, moving mobile construction plant on site. Studies conducted by Peckitt et al., (2004) and Gibb & Bust (2006) on health and safety (H&S) management in construction in developing countries provide ample evidence of lapses in the management of H &S at construction sites. Their findings revealed weaknesses in occupational health and safety administration, economic conditions, climatic conditions and the characteristics of the construction industry of developing countries influence H&S programs is absent in most construction businesses in developing countries.

The risks that these hazards pose are often unacceptably high on construction sites. Traditionally, measures are taken to eliminate these hazards where possible, or reduce their risks to an acceptable level on construction sites. However, measures taken to control risks of

hazards on construction sites in developing countries are unsatisfactory (Gibb and Bust, 2006). Consequently, lack of knowledge and usage of safety tools and techniques on the part of building contractors in managing safety on construction sites means the recurrence of accidents on sites subsequently rendering any safety policy of that organization redundant. The Ghanaian Government needs to address these issues to increase productivity of the construction sector in line with its growth program. Thus this study seeks to address this issue by exploring the level of knowledge and usage of safety tools by contractors in Ghana.

1.3 AIM & OBJECTIVES OF THE STUDY

1.3.1 AIM

The aim of the study was to explore the level of knowledge and usage of safety control tools and techniques by Building Contractors in Ghana.

1.3.2 Objectives

To achieve the aim of the study, the following objectives were pursued:

- To assess the level of knowledge of safety control tools and techniques by Ghanaian Contractors;
- To assess the level of usage of safety control tools and techniques by Ghanaian Contractors; and
- To identify practical safety measures required to improve safety in building construction sites in Ghana.

1.4 SIGNIFICANCE

It is important to note that the effective Occupation of health and safety control systems in construction industry do not only minimize the casualties and accident in construction site but also reduces their intensity and risks of hazards at workplaces. In addition, when the workers in the industry have enough knowledge on safety especially, it helps in controlling accident

cases. 'All is well that ends well', but in this case all is not well with the health and safety in the construction industry in our quest to minimizing the accident that occurs in the construction industry and if not totally eliminated, hence the need to find out why the health and safety in our industry have become ineffective especially amongst construction firms in Ghana.

Also when the occupational health and safety practices in the industry is improved there will be absence of increase in the risk of being accident prone, where workers will work under protected and safe environment which lead to economic, efficient and effective use of materials and tools. In addition, my observations have revealed that, workers are exposed to new chemical, Psychosocial and physical hazards that are emerging from new forms of industrial processes and Work organization. A lot of accidents and injuries do occur to employees, which when controlled properly could avoid permanent disability or the victim having to leave the work afterwards. It is important to know that, occupational injury, illness and fatality currently accounts for significant losses, with over 3% GDP losses annually due to these causes. This means investments in occupational health and safety can thus bring gains in productivity and market access (Loewenson, 1998). Findings from the research will provide insights into health and safety management at construction sites and contribute to understanding of the health and safety behaviour of building contractors in Ghana.

1.5 METHODOLOGY

This study employed a descriptive study design, employing self-administration of structured questionnaire and face to face interview to collect the study data. In short, to obtain adequate facts regarding the subject matter the study was based on the following methods:

- Reading relevant literature / Journals;
- Semi structured interviews with contractors and consultants;
- Questionnaire to contractors / consultants, project managers, workers, etc.; and
- Site studies of some selected construction site, Health and Safety offices within Kumasi Metropolis.

1.6 SCOPE OF THE STUDY

Due to the limited resources (i.e. Time and finance) the study was conducted within Kumasi Metropolis. This study was limited to construction companies with D1K1 and D2K2 category in the Kumasi Metropolis in the Ashanti Region of Ghana. Ashanti Region was selected due to it being one of the largest city in terms of land area in Ghana.

1.7 STRUCTURE OF THE STUDY

The study is structured in five chapters. Chapter one introduces the study with relevant background, problem statement, objectives of the study and the structure of the study. Chapter two comprised a historical and relevant literature review from previous studies on safety control tools and techniques. Chapter three showed the methodology that was used in this research in order to achieve the required objectives. It involved questionnaires, interviews, observations and interactions with the health and safety officers, sources of data, method of analysis, assumptions, expectations and limitations of the study. Chapter four comprised the empirical results both statistical and economic analysis, perspective and discussion of research results through the data collected. Chapter five provided the summary, conclusion and recommendation emanating from the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter reviews relevant literature in the aspect of safety management systems in construction. From the backdrop of health and safety in Ghana, the literature explores the legal institutions in this aspect and goes further to review studies on safety control on construction sites. The construction industry has been recognised statistically as one of the most hazardous industries in many countries (Carter & Smith, 2006). Besides causing human tragedy, construction accidents also delay project progress, increase costs, and damage the reputation of the contractors (Wang et al., 2006). The risk characteristics of a construction site are influenced by the amount of effort required to reduce the accident risk of the site by, for example, protecting the workforce from hazards and taking the necessary safety measures. Hazardous locations and high-risk time periods can be effectively predicted if safety management and scheduling are coordinated.

2.2 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT IN GHANA

Occupational health and safety legislation is very important as it serves as a means by which the working environment can be controlled to ensure the safety, health and welfare of employees and persons likely to be adversely affected by the work environment are protected. In Ghana, occupational health and safety legislation is largely influenced from the British due to it been inherited from a British institutional framework at the time when Ghana was a British dependency. The health and safety of workers in the mining and wood processing industries of Ghana prior to independence, was protected by the Factories Ordinance 1952. This remained the main occupational health and safety legislation in force until its repeal by

the Factories, Offices, and Shops Act 1970. Ghana's occupational health and safety legislation is influenced by the International Labour Organisation (ILO).

2.2.1 Health and safety legislation relevant to the construction industry

There are no health and safety regulations developed specifically for the construction industry. Due to the high risk nature of the sector, this serves as a serious limitation which adversely affects 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 and Shops Act are briefly discussed in the sections that follow.

2.2.1.1 The Factories, Offices and Shops Act

The Factories, Offices, and Shops Act 1970 cater 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 on sites. 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 (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). 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. 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.

2.2.1.2 The Labour Act

Part XV of the Labour Act, 2003 (Act 651) concerns the health and safety and environment of workplaces. The major aspect of this act is that it requires employer's 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' organisations and collective bargaining agreements; National Tripartite Committee; and, labour inspection.

2.2.1.3 The Workmen's Compensation Law

The Workmen's Compensation Act 1987 imposes employer liability to pay compensation to employees injured by accidents arising due to their work. 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 organisations. The Act sets out modalities for calculation of the earnings of workers and payments of compensations to workers who sustain injuries.

2.3 SAFETY MANAGEMENT IN CONSTRUCTION

2.3.1 Safety management systems

Most construction professionals manage safety by carrying out health and safety activities aimed at minimizing or eliminating the risk of hazards on their sites. Hamid et al. (2004) averred that there are a growing number of construction companies, particularly larger ones, have tended to adopt health and safety management systems which have their origin in Deming's Plan-Do-Check-Act model of continuous quality improvement. Essentially, a health and safety management system has four primary elements:

- planning;
- implementing the plan;

- reviewing the plan; and
- evaluating and taking measures to improve strategy.

Helledi (1999) reported on the adoption of a simple, non-bureaucratic health and safety management system by SMEs in the Finnish construction industry which proved effective in bringing down the numbers of site accidents experienced by contractors. The elements of the health and safety management system comprised: a planning phase involving the assessment of risk; an implementation phase involving communication of critical tasks to be carried out on site; a control phase involving monitoring the activities; and, a follow up phase which provides feedback and enables corrective measures to be taken. Approaches to health and safety management reported in construction hardly qualify as health and safety management systems because they lack one or more of the elements of Deming's Plan-Do-Check-Act (PDCA) cycle. For instance, Agrilla's (1999) 3Es suggested for achieving high safety performance comprises; safety engineering, safety education and safety rule enforcement. This health and safety management system involves planning as part of the safety engineering process but lacks clear elements or procedures on how to continuously improve health and safety performance.

The effectiveness of health and safety management systems in the construction industry has not been assessed. At best, it is only the individual elements that make up the system which have been shown to be associated with improved health and safety performance. The adoption of comprehensive health and safety management systems has been shown to be a difficult task for SMEs (Dawson et al., 1988; Eakin et al., 2000; Mayhew 2000). Some reasons as to why SMEs might find it difficult adopting such systems include lack of adequate resources, the fact that they operate in a competitive environment and operate under relatively informal management procedures (Banfield et al., 1996; Mayhew, 1997; Vassie et

al., 2000). There is, therefore, reason to doubt the applicability of comprehensive health and safety management systems to construction SMEs.

2.3.2 Behavioural approaches to safety management

A number of theories have linked accidents to the failure of persons (by their actions or omissions) in the accident 76 chain to avert accidents (Haslam et al., 2005; Suraji et al., 2001).

These explanations have therefore formed the basis of psychological approaches to health and safety management which have as their aim, the modification of behaviour so as to break the chain of events leading to most accidents. Duff et al. (1998) reported on behavioural modification procedures used in improving construction site safety. The authors of the study used a combination of goal-setting and feedback to influence the behaviour of site operatives. The findings of the study suggest goal setting and feedback can greatly enhance health and safety performance. Duff (1998) has pointed out that behavioural methods should not be restricted to site operatives but could be extended to include site management staff and senior corporate management. Lingard and Rowlinson (1997) examined the effectiveness of the goal-setting and feedback approach in the Honk Kong construction industry. It was found that labour commitments to the group and to the organisation are intervening variables in the application of behavioural techniques.

Workers need to behave on site in a manner that will not expose them or their colleagues to hazard, particularly workers need to:

- report incidences to their employers;
- take care of their own health and safety;
- abstain from alcohol and drugs that would otherwise increase their exposure to hazards;

- take care to avoid adversely affecting the health and safety of fellow workers and persons likely to be adversely affected by their actions and omissions;
- follow health and safety rules on site; and,
- use PPE when provided.

2.4 SAFETY CULTURE AND SAFETY CONTROL

Safety culture and safety climate are constructs that evolved in the 1980s from the broader concepts of organizational culture and organizational climate. Organizational culture and climate have different meaning including when the focus is more specifically on safety. Unfortunately, neither the research literature nor the practical application of these concepts has offered clear or consistent distinctions, which has resulted in considerable definitional confusion. For this review, we have chosen just a few definitions that we believe capture the essence of safety culture and safety climate and help address the cause and effect debate. Some authors (Guldenmund, 2000; Schein, 1992) present a model of culture and climate as a layered phenomenon where the core of culture (the inner layers) comprises constructs such. As basic values, assumptions, principles, or convictions and the more visible expressions of culture like rituals, artifacts, and heroes, are located in the outer layers Another way authors attempt to clarify these concepts is by analogy with the study of personality as in: culture is analogous to the relatively fixed personality trait, while climate corresponds to the more variable mood state (Cox & Flin, 1998), or through other familiar terminology: …climate is commonly associated with terms such as "superficial" … "snapshot," "quantitative," and "state," whereas culture with "deep," "stable," "qualitative," and "trait." (Seo et al., 2004).

2.4.1 Safety Culture

The origin of the safety culture concept is easily traced. The International Atomic Energy Agency (IAEA) and OECD Nuclear Agency identified "poor safety culture" as a prominent factor in the 1986 Chernobyl nuclear disaster in the former Soviet Union (Cox & Flin, 1998). A UK nuclear safety panel developed a definition of safety culture that became the "market standard" in that country: The safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management (HSC, 1993).

2.4.2 Safety Climate

Zohar published the first safety climate study in 1980, where he developed and tested a model of safety climate using a 40-item questionnaire, which he administered to workers in 20 Israeli factories across a variety of industries. He defined safety climate as "a summary of molar perceptions that employees share about their work environment" (Zohar, 1980). This study established what has become the common way to assess safety climate: a questionnaire whose items (questions) measure a set of factors or constructs that reveal shared perceptions of the organization's safety climate. Zohar's original set of factors were:

- Importance of safety training;
- Effects of required work pace on safety;
- Status of safety committee ;
- Status of safety officer ;
- Effects of safe conduct on promotion ;
- Level of risk at work place ;
- Management attitudes toward safety ; and
- Effect of safe conduct on social status (Zohar 1980).

Many subsequent studies began from this list, but methodological and population differences have been a barrier to identifying a consistent core set of factors and definitions (Flin et al., 2000). That said, Seo and colleagues (2004) concluded that the set of critical factors in subsequent literature had not significantly diverged from Zohar's original set, finding that the themes clustered into five core constructs of safety climate: management commitment to safety, supervisory safety support, coworker (safety) support, employee (safety) participation, and competence level.

2.4.3 Behavior Based Safety and Safety Culture

The ongoing quest to define and measure safety culture and climate has inevitably become intertwined with the hundred-year-old debate about the management's responsibility to create safe conditions on the one hand and workers to behave properly on the other to reduce accidents. While more sophisticated and multi-factorial models of incident causation have been developed in recent decades, (the "New View of human error" in Dekker's (2006) words), the "Old View" remains strong in many occupational safety and health circles. The "old view" is best represented by H.W. Heinrich's two "theories": 1) The 88-10-2 ratio of accident causation, i.e. 88% unsafe acts of persons, 10 percent unsafe mechanical or physical conditions, 2 percent unpreventable; and 2) the pyramid which holds that for every one major injury 29 minor injuries and 300 no-injury accidents would have occurred. Manuele (2011) details the fallacies and misuse of Heinrich's data, but the point is that many of these ideas still have great currency in the world of occupational safety and health practice.

Given this, it is not surprising then that critics of the burgeoning attention to safety culture, particularly in the context of high risk/high reliability industries, warn that although invocation of safety culture seems to recognize and acknowledge systemic processes and effects, it is often conceptualized to be measurable and malleable in terms of the attitudes and

behaviors of individual actors, often the lowest-level actors, with least authority, in the organizational hierarchy. (Silbey, 2009) The risk of conceptualizing safety culture/climate this way is most clearly illustrated by the investigation of the catastrophic explosion at the BP Texas City refinery in 2005. BP's reliance on individual injuries, i.e. recordable injury rate, as an indicator that process safety was being adequately managed and that a healthy safety culture was maintained proved to be deadly (HSE, 2009).

This is not to suggest that behavior is off limits when defining or studying safety culture. It is essential to understand human behavior and human error for preventing adverse safety events and organizational accidents (Dekker, 2006; Reason, 1997). Indeed, behavior is included in most models that describe accident causation and workplace safety, including those encompassing safety cultures. Cooper (2000) proposed a model called "reciprocal determinism" with the three primary variables of person (internal psychological), situation, and behavior interacting in dynamic ways. The balance of how these three pillars interact varies depending on the situation. Choudhry et al., (2007) applied Cooper's model to construction by including three measurement techniques: safety audits for the environment/situation, perceptual audit of safety climate for the person, and behavioral sampling for behavior.

The difficulty arises when certain elements or causal factors are overemphasized in these models without having credible evidence for doing so. Examples of this are unfortunately common in the safety culture literature (see for example Choudhry et al., 2007). The oft-cited UK Keil Report acknowledges four categories of critical health and safety behaviors- frontline behaviors, risk control behaviors, management actions, and leadership and direction (Fleming & Lardner, 2002). However, it is only the first that is generally observed in behavior based safety (BBS) programs in part because measuring the latter three categories is

more difficult. This is reflected in the fact that the majority of safety culture/climate related intervention studies are directed toward changing frontline

2.4.4 Safety Control

Anderson et al, (2004) averred that safety control is a person's perception of the ability or opportunity to manage work situations to avoid injuries and accidents. In their job strain model, Karasek and Theorell (1990) contended that job strain results from demands at work in relation to the amount of perceived control or freedom of decision-making the individual has while facing the demands of the job, not the work environment per se. Prior research has consistently shown that a high level of job control is positively associated with health and well-being (Glass and McKnight, 1996), and with job satisfaction and motivation For example, Spector and colleagues have 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 and Smith, 2006) and an essential component of occupational health and safety (OHS) legislation (Trethewy et al., 2003). However, the findings of Carter and Smith (2006) indicate that current hazard identification levels in construction projects are far from ideal. These authors identified several significant barriers to improving hazard identification: knowledge and information barriers (i.e., failure to share information across projects, lack of resources in smaller projects, subjective hazard identification and risk assessment, and reliance upon tacit knowledge), and process and procedure barriers (i.e., lack of a standardized approach, and undefined structures for tasks and hazards).

Most contractors see their health and safety plans, which must include full risk assessment, as merely a burdensome requirement that they must fulfill in order to avoid government fines. As a result, they often neglect the proper implementation of these plans (Wang et al., 2006). 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 et al., 2006). 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 (CHPtD), in which engineers and architects explicitly consider, during the design process, the safety of construction workers (Toole & Gambatese, 2008). As noted by Toole and Gambatese, even though articles on CHPtD have appeared in top construction journals, the literature has not yet addressed the technical principles underlying CHPtD in order to help designers better perform CHPtD and to facilitate the development of additional CHPtD tools. Additional tools and processes are needed in order to assist architects and design engineers with hazard recognition and design optimization (Gambatese et al., 2008).

2.5 TOOLS AND TECHNIQUES FOR SAFETY CONTROL

Hazard identification and control must be conducted before the construction phase begins to ensure that safety challenges are avoided as the means, methods, and site layout is designed (Hinze, 2006). Once construction starts, workers and foremen must conduct pretask planning meetings every day to ensure that hazards are recognized and communicated prior to worker exposure. Safety control involves determining and applying measures for monitoring the achievement of specific project results throughout the project to determine whether they comply with the safety requirements. The tools used in this study are based on those

described in the Construction Extension to a Guide to the Project Management Body of Knowledge (PMBOK Guide, 2007). The guide 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 figure shows three main aspects of the project safety management; safety planning, safety assurance and safety control. This research focuses on the use of safety control tools and thus delves into the use of those tools. Eleven tools can be identified from the use of safety control tools. The tools are discussed in the ensuing sections.

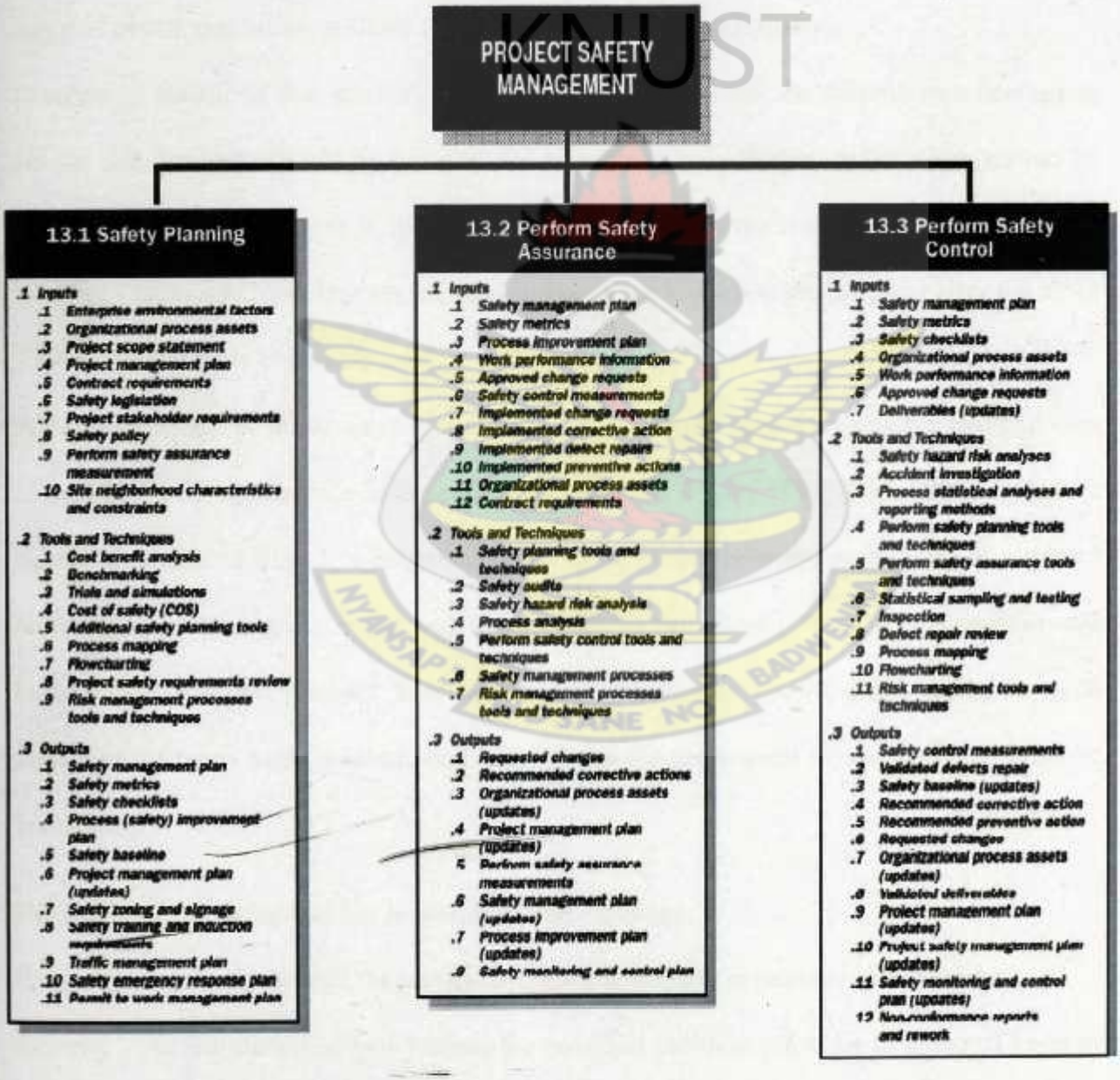

Figure 2.1. Project Safety Management Overview

Source: PMI (2007)

2.5.1 Safety Hazard Risk Analyses

During a risk assessment, hazards are evaluated in terms of the likelihood that a problem may occur and the damage it would cause if such an event did occur (PMI, 2007). Adequate safety and emergency preparedness requires considering all of the possible hazards that could be encountered. Some hazards, however, are more likely to cause problems than others and some would result in greater damage than would others. These differences are identified by conducting a risk analysis. The outcome of the analysis can be used to target resources at the types of events that are most likely to occur and/or are most destructive.

Emergency situations that are very likely to happen and would do considerable damage to people and property should be targeted for immediate remediation and/or plans should be made for effective response if remediation isn't possible. Potential situations that are less likely or that would have less severe consequences are identified for attention after the more serious hazards have been addressed.

While there might be many ways of assessing risk, literature suggests using the two concepts of probability of occurrence and severity of effects [DeVaul 1992; Hau 1993]. For each hazard identified in Step 3, a judgment needs to be made about the probability of a hazard resulting in an emergency event and the severity of the consequences if the situation did happen. The attached "Hazard Risk Matrix" can be used to record a risk rating for each hazard in the terms high, medium, and low. To use the assessment several concepts must be understood.

Hazard – Any situation that has potential to cause damage

Probability – Likelihood that the particular hazard will result in damage at this location.

Severity – An estimation of how serious the potential problem might be in terms of harm to people and/or damage to property.

It should be kept in mind that secondary incidents can occur as a result of the initial incident. In summary, to assess risk: (a) identify potential hazards; (b) determine whether the probability is high, medium, or low that the source will actually cause damage; and (c) determine if the seriousness to life, property, and the environment of such a hazard would be high, medium, or low. These analyses are normally carried out by specific and knowledgeable members of the project management team with the assistance of key construction supervisors

2.5.2 Accident Investigation

Considerable efforts have been extended towards the field of accident investigation following the seminal work by Heinrich (1959). The resultant effect is the several accident causation models developed, generally with the overall aim of providing tools for better industrial accident prevention. Hughes and Ferrett (2008) averred that an accident is any unplanned event that results in injury or ill-health of people, or damage or loss to property, plant, materials or the environment or a loss of a business opportunity. Accidents are strongly associated with adverse outcomes which have dire cost implications for the construction industry and society as a whole (Hughes and Ferrett, 2008). The adverse outcomes of accidents have created the need for accident prevention which requires knowledge of accident causal factors, how the causal factors contribute to accident causation, the extent to which causal factors contribute to accident causation, and the risk posed by these factors (Hughes and Ferrett, 2008).

It is important that each accident be investigated as to cause (direct and/or indirect) and a complete report should be made stating what happened and why. These reports are usually required by the insurance companies covering the resulting losses but the reports are also vital as a measure of and for the improvement of the performing organizations safety

performance. In some cases there reports are required by law enforcement agencies. Accident investigations should consider why human failures occurred. Finding the underlying (or latent, root) causes is the key to preventing similar accidents.

2.5.3 Process statistical analyses and Reporting methods

The basic problems when carrying out statistical safety analysis involve selecting the most hazardous scenarios which have the biggest impact on risk assessment. Statistical safety analysis is carried out by a team of experts which as a rule consists designers.

Common statistical and reporting methods for safety management include

2.5.3.1 Cause and effect analyses

Cause and effect diagrams also called Ishikawa diagrams or fishbone diagrams, illustrate how various factors might be linked to potential problems or effects (PMI, 2007).

2.5.3.2 Control Charts

Even though they are not often used in construction, control chart's purpose is to determine whether or not a process is stable or has predictable performance. Control charts may serve as a data gathering tool to show when a process is subject to special cause variation, which creates an out-of-control condition. Control charts also illustrate how a process behaves over time.

2.5.3.3 Histograms

A histogram is a bar chart showing a distribution of variable. Each column represents an attribute or characteristic of a problem/situation. The height of each column represents the relative frequency of the characteristic (PMI, 2007).

2.5.3.4 Pareto analyses:

Parcto chart is a specific type of histogram, ordered by frequency of occurrence which shows how many defects were generated by type or category of identified cause. The Pareto techniques is used primarily to identify and evaluate nonconformities. In Pareto diagrams, rank ordering is used to guide corrective action (PMI, 2007).

2.5.3.5 Run Analyses

A run chart shows the history and pattern of variation. A run chart is a line graph that shows data points plotted in the order in which they occur. Run charts show trends in a process over time, variation over time, or declines or improvements in a process over time (PMI, 2007).

2.5.3.6 Scatter Analysis and Diagram

A scatter diagram shows the pattern of relationship between two variables. This tool allows the quality team to study and identify the possible relationship between changes observed in two variables. Dependent variables versus independent variables are plotted. The closer the points are to a diagonal line, the more closely they are related (PMI, 2007).

2.5.4 Perform Safety Planning Tools and Techniques

Safety planning involves determining how to approach, plan and execute the requirements for project safety management. Determining the applicable requirements which define the criteria 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. Assessing how best to apply the applicable acceptance criteria, documenting their characteristics and associated risks, and determining how to satisfy them. Determining how the suitability and effectiveness of project safety management will be assessed or determined. 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. Saurin et al., (2006) have shown how the safety planning process involves risk identification, evaluation, and control, and that the main steps for producing safety plans are:

- Establishing the necessary tasks to be undertaken;
- Identifying the existing risks; and
- Defining how each risk will be controlled.

2.5.5 Perform Safety Assurance Tools and Techniques

Perform safety assurance involves; applying the planned systematic safety activities to ensure that the project employs all processes needed to meet requirements. Determining whether these processes (and their integration) are effective in ensuring that the project management system will fulfil the requirements of the project and product of the project (PMI, 2007). Evaluating the results of safety management on a regular basis to provide confidence that the project will satisfy the relevant safety standards. These tools include safety planning tools and techniques, safety audits, safety hazard risk analysis, process analysis, perform safety control tools and techniques, safety management processes tools and techniques.

2.5.6 Statistical Sampling and Testing

This involves choosing part of a population of interest for inspection (for example, selecting ten engineering drawings at random from a list of seventy-five) (PMI, 2007). Appropriate sampling can often reduce the cost of quality control.

2.5.7 Inspection

An inspection is the examination of a work product to determine whether it conforms to standards. Generally the results of an inspection include measurement. Inspections can be conducted at any level. For example, the results of a single activity can be inspected, or the final product of the project can be inspected. Inspections are also called reviews, peer reviews, audits, and walkthroughs. In some application areas, these terms have narrow and specific meanings. Inspections are also used to validate defect repairs.

2.5.8 Defect Repair Review

This is an action taken by the quality control department or similarly titled organization to ensure that product defects are repaired and brought into compliance with requirements or specifications (PMI, 2007).

2.5.9 Process Mapping

Process mapping is mostly done to map how a particular process is carried out and to determine how various processes interact. It also used to identify any gaps in a particular work item or activity (termed-gap analysis), and include the absence of cri.ical review points or a required deliverable (PMI, 2007).

2.5.10 Flowcharting

Flowcharting helps to analyze how problems occur. A flow chart is a graphical representation of a process (PMI, 2007). There are many styles, but all process flowcharts show activities, decision points, and the order of processing. Flowcharts show how various elements of a system interrelate. Flow enables the project team anticipate what and where quality problems might occur and thus, can develop approaches for dealing with them. Flowcharting is

commonly used with process mapping and with certain process statistical analyses and reporting methods.

2.5.11 Risk management tools and Techniques

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. The main objective of risk management is 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.

Haslam et al. (2005) in their study analyzed 100 accidents in the construction industry and identified that the lack of appropriate risk management is one of the most relevant underlying factors. According to their study, 84% of the accidents could have been predicted and avoided if risk management had been properly carried out. They also noted that a significant portion of the accidents involved workers moving within the construction site or during preparatory activities. Therefore, since they were not involved in any construction activity, there were no risk analysis and no safety measures implemented in most cases. The extrapolation of these conclusions must take into consideration the specific context of the study, both in time and space, and its scope. In fact, there are studies reporting contradictory conclusions (e.g.,Gürcanli and Müngen, 2009) and in overall terms there are similar distributions of the most relevant causes of fatal accidents in the construction industry in various countries, with falls coming in first place invariably. Still, the study of Haslam et al. (2005) has the merit of reinforcing the need for risk analysis not only for the tasks performed

by the workers but for the construction site as a whole and taking into consideration possible interactions between tasks due to spatial and time conflicts.

Various reasons and explanations can be pointed out for the absence of adequate risk management, but the financial issues are often prevalent in comparison to the technical, given the plethora of tools, information and documentation available, accompanied by increasingly demanding legislation and regulations. Wilson and Koehn (2000) claim that, in the majority of the companies, occupational safety and health management is implemented in order to limit the responsibilities and costs associated with accidents and health problems.

2.6 SUMMARY

The construction industry has not had a good record on safety control practices and faces vivid legal and financial penalties for breaches of the law of contract. Most available literature information makes claim that the level of knowledge and usage of safety control tools and techniques are defined and met by all who deem themselves professionals.

This study provides a unique safety management for contractors in Ghana who construct or procure the construction of projects of all sizes and for client who need to keep abreast of their contractors responsibilities

Safety control tools and techniques gives practical guidance on best practices on construction sites in Ghana which includes

- Measuring performance and recording information.
- Developing a safety policy and method statements
- Assessing risk
- Training and understanding people; and
- The basic of construction and environmental interface

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

As aforementioned, the construction industry is saddled with health and safety issues and consequently has been recognised as a volatile industry. A lot of research has been undertaken in this discipline. However, they have all been tailored to look at the impact of safety on the construction industry, especially in the developing economies. Notwithstanding, the industry continues to battle with daily health and safety concerns. The plausible explanation is that the industry and thus its participants lack certain knowledge with regard to the usage of safety control tools techniques. Hence, the need of this research.

After reviewing various literature on the subject matter, this chapter presented the methods of exploring the level of knowledge and usage of safety techniques by the building construction industry. The chapter threw more light on the preliminary survey which was conducted during the literature review process and also defined the research strategy, design and development process that was employed to administer the questionnaires. The characteristics of the population, sample and the sampling techniques that was employed for the study was accordingly discussed in this section; the tool that was adopted for the data analysis is also considered under this chapter.

Ayyash et al. (2011) defined research methodology as procedures, ways, methods and techniques that are employed to capture and gather all the required information for the purpose of the research issue.

3.2 PRELIMINARY SURVEY

Prior to the commencement of the preliminary survey, an extensive literature review was undertaken. The literature review covered extensively on issues making rounds in the discipline; notably a general overview of safety in the Ghanaian Building Construction industry. The Relevance of health and safety to the industry was also looked at. In addition, the existing tools and techniques of safety and their level of knowledge of these tools and techniques were explored. These sections clearly bring forth the tools and techniques employed in dealing with safety issues.

It may however become known midway through the literature review process that most of the tools and techniques, which were identified for dealing with safety, are foreign and also most or all of these tools and techniques are used within a broader perspective of the construction industry without knowing the tools peculiar to the various sectors within the industry. It was prudent and imperative to situate these tools and techniques within the Ghanaian Building Construction Industry. To localize these challenges, an informal preliminary survey which involved some selected construction sites and safety offices was conducted. The survey involved construction sites and health and safety offices because they are constant encounter with safety problems in their daily routine. The process involved both a one-on-one unstructured and semi-structured interview sessions with each session averaging 15 minutes in duration.

3.3 RESEARCH PARADIGM

Research has always been referred to as an endeavour of finding out. However, there are so many ways of conducting it. Over the years, people have dedicated their time and resources to understanding the nature of phenomena it presents to their senses (Cohen et al., 2004 cited from Phiri, n.d.). Research in this sense would mean to search repeatedly for knowledge

hitherto was not known, thus research is an inquiry into something. Hitchcock and Hughes (1989) cited from Phiri (n.d.) argued that this inquiry have its roots in assumptions. Consequently, different researchers may claim different perspectives about these assumptions about the truth of nature and knowledge; and how to arrive at them.

These assumptions, beliefs, values, etc. That a community shares in the conduct of research has been defined as research paradigm (Mangan et al., 2004). However, researchers are divided over these assumptions and the divisions are noted as ontology, epistemology and methodology (TerreBlanche and Durrheim, 1999). Ontology refers to the ways of constructing reality, whereas epistemology defines the knowledge of the different forms of that reality; and methodology considers the particular ways of knowing that reality (Phiri, n.d.). Ontology questions basically borders on how things really are and work (TerreBlanche and Durrheim, 1999). However, epistemological questions tend to ask what nature of relationship exists between the researcher and the research and posit that if "real" reality is assumed, then the position of the researcher must be one of "objective detachment or value freedom" in order to be able to discover the how things really are or work (TerreBlanche and Durrheim, 1999).

Also, methodological questions are those that tend to ask how the researcher can go about finding out whatever he or she may want to believe or know (TerreBlanche and Durrheim, 1999). At the ontology level, two possible world views are identified – Objectivists and Constructivists. Either of these views eventually presents ramifications on the research employed. Consequently, the study employed the objectivists approach at the ontology level. This research is of the view that the level of knowledge and usage of tools and techniques of health and safety are outside the reach and therefore not the constructs of the researcher. Researchers have identifies that the selection of ontological assumptions underpins the

epistemological assumptions (Phiri, n.d.). Accordingly, this study employed the positivism stance as opposed to the interpretivism of epistemology. The Positivist approach also assumes that absolute knowledge is unattainable (Wangombe, 2013). However, according to the Positivists, the world works according to certain fixed laws of cause and effect; and scientific thinking is used to test theories about these laws either to reject or accept those (Wangombe, 2013). Hence, the research was of the opinion that the level of knowledge and usage of tools and techniques of health and safety in the Building construction industry must be carried out in an unbiased way (free of researcher effects) which can be replicated.

Various approaches of arriving at the reality exists, including controlled laboratory experiments, participant observations, action research, etc. However, the methodology adopted for this research was a triangulation methodology involving selected site studies and questionnaire survey.

3.4 RESEARCH DESIGN

Though tools and techniques of health and safety across the globe may present similar characteristics, there would also be more or less profound differences. The continual health and safety issues saddling the Ghanaian Building Construction industry makes it more exigent to explore the level of understanding and usage of the tools and techniques of health and safety employed. In this study, the construct or the thrust is to explore tools and techniques that can be practically implemented in improving the issues at hand based on the combining methods. The type of tools used, the level of knowledge and the level of usage can all be quantitatively be mapped out.

However, Hussein (2009) opined that the combination of quantitative and qualitative approaches in the same endeavour has gained currency among scholars and researchers. This approach has grown to be regarded as the third paradigm and been termed as the

triangulation. It combines both the advantages of qualitative and quantitative methods. However, there has been mixed views about this approach (Hussein, 2009). The research approach employed both qualitative and quantitative methods

3.5 POPULATION AND SAMPLING SIZE

Population in research methodology is understood to be objects, subjects, phenomena, cases, events or activities specified for the purpose of sampling (Brynard and Hanekom, 2005). Also, Population refers to a group or units of interest located in a geographic area of interest during the time of interest (Taylor-Powell, 1998). Consequently, this research was focused on the building construction industry in the Kumasi Metropolis. This choice of location was because of its proximity and convenience for the researcher and for the fact that the data was readily available in this city.

Collecting information from every respondent in the population is mostly very rare.

Selecting a representative part of a population (sample) to determine characteristics or parameters of the whole population is termed as Sampling (Taylor-Powell, 1998). However, Taylor-Powell (1998) argued that sampling may not be necessary if the population is small. Considering time and resources available for the study, the research targeted twenty construction professionals; and two selected building construction sites and health and safety offices.

3.6 SAMPLING TECHNIQUES

Various sampling techniques abound. The choice of a sampling technique depends on the constructs and the mode of conducting the research. Looking at the study at hand, purposive sampling was used to select the sample within the population. Purposive Sampling is a sampling technique whereby the researcher decides who to be engaged in the research. This was selected because it allows information-rich issues that are important to the study to be added and also focus on specifics rather than general (Taylor-Powell, 1998). The choice was based on contractors that engage in large projects that is D1K1 and D2K2, since those projects are susceptible to high level of risks on health and safety issues. Thus their opinion was imperative to this study as they reflect the issues on the ground. In all the total number of forty respondent were involved in the survey, these included Managing Directors, Project Managers, Civil Engineers and Safety Engineers.

3.7 SOURCES OF DATA AND DATA COLLECTION

Evaluation is the process of systematically collecting data that represents the opinion and experience of its participants or other stakeholders (Thomas, 2010). Hence, data collection and the sources from which data would be collected are imperative to understanding the theoretical background of the research (Thomas, 2010). The purpose of this aspect of the research methodology was to present the data collection instruments, methods and procedures.

Primary data are information that the researcher collects because no one has compiled and published for public accessibility (Thomas, 2010). Easterby-Smith et al, (2003) argued that every research should include empirical research data (i.e. primary data). To this end, the primary data sources were collected from construction professionals in the Building construction industry.

The primary technique for collecting the data was a self-administered questionnaire; since it serves as the major source of information (Taylor-Powell, 1998) and can be used to measure issues that are crucial to management and development of human resources, such as behaviours, attitudes, beliefs and expectations. Thus, the design and administration of relevant questionnaires was appropriate for measuring individual's perspectives on health and safety in the building construction industry.

3.7.1 Questionnaire Design and Development

Questionnaire may be defined as a set of carefully structured questions prepared to elicit reliable and statistically useful information from respondents about the research topic. According to Saunders et al,. (2007), questionnaires facilitate the collection of data by asking the sample to respond to the same questions.

3.7.1.1 Questionnaire Planning and components

Questionnaire planning requires a lot of time and attention (Taylor-Powell, 1998). Questionnaire planning starts with writing a good, non-biased, answerable question that can give good data and insight into the problem at hand since people tend to answer questions asked them and not necessarily what they are needed to address (Taylor-Powell, 1998). Consequently, the kind of evidence needed to fulfil the purpose of the study and how the information was used were essential in questionnaire planning (Taylor-Powell, 1998).

However, Denscombe (2003) indicated the elements that need to be considered during the planning stage of the questionnaire. These included

- Costs;
- Design time frames;
- Distribution, collection and analysis processes; and

- Time-span for receiving results.

In line with the above elements, the questionnaire was thoroughly and meticulous planned.

3.7.1.2 Ethical and general considerations

Welman et al. (2005) explained that ethical considerations and ethical behaviour are as important in research as they are in any other field of human activity. Essentially, the rights of respondents as human beings should always be respected at all times Welman et al. (2005). Consequently, the respondents were assured that their privacy would be preserved so as to elicit responses without fear or intimidation (Badu et al., 2013). As such the ethical considerations as shown in the table 3.1 below underpinned this study.

Table 3.1 Ethical considerations;

Competence	A researcher should not embark on research involving the use of skills in which they have not been adequately trained. To do so may risk causing harm to subjects, abusing a subject's goodwill, damaging the reputation of the research organisation, and may involve wasting time and other resources.
Plagiarism	The use of other people's data or ideas without due acknowledgement and permission where appropriate is unethical.
Falsification of results	The falsification of research results or the misleading reporting of results is clearly unethical.

Source: Welman et al. (2005)

3.7.1.3 Steps in designing the questionnaire

Questionnaire provides a tool for eliciting information which can be tabulated and discussed (Taylor-Powell, 1998). Accordingly, Wai-Ching (2001) opined that two main objectives must guide questionnaire design – to maximize the response rate and to obtain accurate relevant information for the survey. Consequently, these two objectives guided the designing of the

questionnaire for this survey. A rapport would be established with the respondents, contacts were also taken to remind those who may be late in responding.

The structure of the questionnaire was accordingly planned with thoughts given to some relevant questions to ask, how the questions are asked and the general layout of the questionnaire. In his document, Wai-Ching (2001) argued that the way a questionnaire is worded has an enormous impact on the nature of information elicited. Consequently, the questionnaire for this study was carefully worded using short and simple sentences. The questions were clear and unambiguous. With a 4-point likert scale ranking, a clear instruction was set out as to how those questions are supposed to be answered. The questionnaire was structured such that the respondents can take up to ten (10) minutes to answer it. Taking longer time may risk putting off the respondents completing the questionnaire.

3.7.1.4 Content

According to Wai-Ching (2001), there is no universal agreement about the optimal length of the questionnaire and the number of pages. However, he further argued that the length should depend on the type of respondents. Short simple questionnaires have been noted of yielding high response rate (see for instance Wai-Ching, 2001). Guided by these principles, the layout of the questionnaire was on an A4 paper with a Times New Roman font style and a 12 font size. The questions were adequately spaced to avoid respondents missing some questions. The questionnaire was in four main sections – A, B, C and D:

- Section A covered personal data of the respondents i.e. the background of the respondents such as name of company, job position, level of education, and years of experience in the construction industry.

- Section B presented the eleven health and safety control tools and techniques for respondents to demonstrate those they are familiar with by ticking appropriately and also their level of knowledge by rating on the 4-point likert scale.
- Section C was designed to assess respondents' level of usage of the eleven safety control tools that was identified in the section B. The mode of answering was also in a likewise manner a 4-point likert scale.
- Last but not least, the Section D presented options of improving the eleven health and safety tools.

3.8 DATA PRESENTATION AND ANALYSIS

The retrieved questionnaire was coded and analysed using simple statistical tools such as the Statistical Package for Social Sciences (SPSS) version 20.00 and Microsoft Excel. To elucidate the discussion in this discipline, the data obtained was presented graphically and in tabular form. The outcome of the study was assessed in line with the research objectives and questions.

Non-parametric statistical testing such as descriptive statistics and mean score index was utilised.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents the collated data, and analyses the data to address the specific objectives in Chapter One of the study. The major areas the chapter discusses include respondent's background information, the safety control tools and measures in the construction industry and the level of knowledge of respondents about safety control tools and the level of usage of safety control tools in the construction industry, and the possible strategies to improve safety control in the construction industry.

4.2 SOCIO DEMOGRAPHIC BACKGROUND OF RESPONDENTS

This section of the study discusses the socio demographic background of the studied respondents in the construction industry. The major socio demographic variables discussed are the class of company, level of education, profession, job position in the company, years of experience in the construction industry and years of company existence. The result about the background information discussed in presented in Table 4.1.

Table 4.1: Socio Demographic Information of Respondents

Classification of Company	Frequency	Percentage
D1K1	14	35.0
D2K2	26	65.0
Level of Education		
Doctorate	4	10.0
Masters	3	7.5
First Degree	21	52.5
Diploma	11	27.5
Others	1	2.5
Profession		
Civil Engineer	5	12.5
Building Technologist	16	40.0
Safety Manager	5	12.5
Construction Project Manager	6	15.0
Quantity Surveyor	7	17.5
Others	1	2.5
Job Position in the Company		
Managing Director	7	17.5
Project Manager/Contract Manager	20	50.0
Safety Engineer/Officer	6	15.0
Civil Engineer	6	15.0
Others	1	2.5
Years of Experience in the Construction Industry		
0-5 years	4	10.0
6-10 years	18	45.0
11-15 years	13	32.5
16-20 years	2	5.0
Over 20 years	3	7.5
Years of Existence of Company		
0-5 years	10	25.0
6-10 years	15	37.5
11-15 years	10	25.0
16-20 years	1	2.5
Over 20 years	4	10.0

Source: Field Survey, 2014

From Table 4.1, out of the total surveyed respondents of 40 in the construction industry, the majority (65.0%) have their company in the D2K2 class of construction companies, whereas 35.0% have their company in the D1K1 class of companies. The highest level of education of

the majority (52.5%) of the surveyed respondents in the construction industry were first degree, whereas 27.5% have diploma. However, 10.0% of the surveyed respondents have doctorate degree. The major profession of the majority (40.0%) of the surveyed respondents of the study was Building Technology, whereas the profession of 12.5% of the surveyed respondents was engineering. However, the profession of 12.5%, 15.0% and 17.5% of the surveyed respondents were Safety Management, Construction Project Management and Quantity Surveying respectively. The job position of the majority of the surveyed respondents in their respective companies in the construction industry was project manager or Contract Manager, whereas that of 17.5% of the surveyed respondents was Managing Director. However, 15.0% of the surveyed respondents were safety engineers or officers in their respective companies in the construction industry. The majority of the surveyed respondents of the study have 6 to 10 years of working experience in the construction industry, whereas 32.5% also have 11 to 15 years of working experience in the construction industry. The majority of the companies of the survey respondents in the construction industry have been in existence for 6 to 10 years, whereas 25.0% have been in existence for 0 to 5 years. The background information was done to give enough credibility and data that was collected.

4.3 KNOWLEDGE OF SAFETY CONTROL TOOLS AND TECHNIQUES

This section of the study assesses the knowledge of the surveyed respondents on the major eleven identified safety control tools and techniques used in the construction industry. The result of the section is presented in the Table 4.2.

Table 4.2: Safety Control Tools and Techniques

Safety Control Measures	Know	Don't Know
Safety hazard risk analyses	37(92.5)	3(7.5)
Accident investigation	37(92.5)	3(7.5)
Process statistical analyses and reporting methods	35(80.0)	8(20.0)
Perform safety planning tools and techniques	35(87.5)	5(12.5)
Perform safety assurance tools and techniques	35(87.5)	5(12.5)
Statistical sampling and testing	29(72.5)	11(27.5)
Daily or routine inspection	29(72.5)	11(27.5)
Defect repair review	30(75.0)	10(25.0)
Identify the process of each activity and how they interact	30(75.0)	10(25.0)
Identifying the value added activities using diagram	39(97.5)	1(2.5)
Risk management tools and techniques	39(97.5)	1(2.5)

Percentages are in Parentheses, Source: Field Survey, 2014

The above control measures were propounded by PMI (2007). The study sought to obtain information about respondents' knowledge of these measures. From Table 4.2, out of the total surveyed respondents of 40 in the construction industry, the majority (92.5%) know about safety hazard risk analyses. The majority (92.5%) of the surveyed respondents of the study also know about accident investigation in the construction sector or industry. The majority (80.0%) of the surveyed respondents of the study have knowledge about the process statistical analyses and reporting methods employed in the construction industry as safety control tools and measures in the construction industry. Some of the statistical analytical tools and reporting methods the surveyed respondents were aware of their adoption in the construction industry as a measure of safety control were collection of statistical data, analysis of statistical data and reporting of statistical data. The majority (87.5%) of the surveyed respondents of the study were also aware of the performance of safety planning tools and techniques such as practical plan to avoid dangerous occurrences on site in the construction industry.

The majority (87.5%) of the surveyed respondents of the study were also aware of the usage of safety assurance tools and techniques such as the application of safety practices to reduce risks on site in the construction industry. The majority (72.5%) of the surveyed respondents of the study know about statistical sampling and testing, and daily or routine inspection as a safety control tool in the construction industry in Ghana. The majority (75.0%) of the surveyed respondents of the study are believed to know about defect repair review, and the identification process of each activity and how they interact (Process Mapping) as major employed safety control tools and measures in the construction industry in Ghana. The result of Table 4.2 also shows that the majority (97.5%) of the surveyed respondents know about identification of the value added activities using diagrams such as flowcharts as major safety control measures or tools in the construction industry in Ghana. The majorities (97.5%) of the surveyed respondents also perceive to know about risk management tools and techniques as safety control tools and measures in the construction industry.

4.4 LEVEL OF KNOWLEDGE OF SAFETY CONTROL TOOLS AND TECHNIQUES

This section of the study assesses the level of knowledge of the surveyed respondents on safety control tools and measures in the construction industry. To achieve this objective, the surveyed respondents were presented with eleven safety control tools and measures identified in literature to indicate their level of knowledge about them by choosing between 'Not at all' [1] to 'Very good knowledge' [4]. The result on the respondent's level of knowledge about safety control tools is presented in Table 4.3.

Table 4.3: Level of Knowledge about Safety Control Tools and Techniques

Safety Control Measures	1	2	3	4
Safety hazard risk analyses	3(7.5)	2(5.0)	26(65.0)	9(22.5)
Accident investigation	4(10.0)	9(22.5)	21(52.5)	6(15.0)
Process statistical analyses and reporting methods	3(7.5)	10(25.0)	21(52.5)	6(15.0)
Perform safety planning tools and techniques	4(10.0)	10(25.0)	20(50.0)	6(15.0)
Perform safety assurance tools and techniques	4(10.0)	7(17.5)	22(55.0)	7(17.5)
Statistical sampling and testing	2(5.0)	3(7.5)	25(62.5)	10(25.0)
Daily or routine inspection	7(17.5)	6(15.0)	21(52.5)	6(15.0)
Defect repair review	8(27.5)	23(57.5)	7(25.0)	1(15.0)
Identifying the process of each activity and how they interact (process mapping)	5(12.5)	8(20.0)	21(52.5)	6(15.0)
Identifying the value added activities using diagram	2(5.0)	3(7.5)	25(62.5)	10(25.0)
Risk management tools and techniques	1(2.5)	5(12.5)	7(17.5)	27(67.5)

Rank: [1-Not at all, Limited-2, Working Knowledge-3, Very Good Knowledge-4]

Percentages are in Parentheses, Source: Field Survey, 2014

From Table 4.3, out of the total surveyed respondents of 40, the majority (65.0%) have working knowledge about safety hazard risk analyses of the companies in the construction industry in Ghana. The construction companies evaluates hazard in an attempt of assessing risk that occur during the project cycle. The majority (52.5%) of the surveyed respondents perceive to have working knowledge about accident investigation in the construction industry in Ghana as safety control tool. This was not surprising as Heinrich (1959) stated that various companies have extended effort in investigating accidents on site. The ripple effect of this is that, various models have been developed to control accident occurrence (Ibid). The majority (52.5%) of the surveyed respondents of the sampled construction companies perceived to have working knowledge about process statistical analyses and reporting methods used in the construction industry in Ghana as safety control tools. The majority (50.0%) of the surveyed respondents of the studied construction companies perceive to have working knowledge about the performance of safety planning tools and techniques such as practical plan to avoid

dangerous occurrences on sites as safety control tools and measures in the construction industry in Ghana.

The majority (55.0%) of the surveyed respondents of the sampled construction companies for the study believed to have working knowledge about safety assurance tools and techniques such as the application of safety practices to reduce risks on site used in the construction industry in Ghana. The majority (62.5%) of the surveyed respondents of the study perceived to have working knowledge about statistical sampling and testing as safety control tools in the construction industry in Ghana. The majority (52.5%) of the surveyed respondents of the sampled construction companies for the study perceived to have working knowledge about daily or routine inspection practices as safety control tool and measure in the construction industry in Ghana. The majority (52.5) of the surveyed respondents also have working knowledge about identifying the process of each activity and how they interact (Process Mapping) as safety control tools in the construction industry. Furthermore, the majority (62.5%) of the surveyed respondents from the sampled construction industries for the study believed to have working knowledge about identifying the value added activities using diagrams such as flowchart as safety control tool in the construction industry in Ghana. However, the majority (57.5%) of the surveyed respondents of the sampled construction firms perceived to have limited knowledge about defect repair review as safety control tool in the construction industry in Ghana. The majority of the surveyed respondents of the sampled construction firms also believed to have very good knowledge about risk management tools and techniques as safety control tool and measure in the construction industry in Ghana.

Table 4.4: Level of Knowledge about Safety Control Tools and Techniques

Safety Control Measures	1	2	3	4	Weighting	RI	Rank
Safety hazard risk analyses	3	2	26	9	121	0.76	4
Accident investigation	4	9	21	6	109	0.68	7
Process statistical analyses and reporting methods	3	10	21	6	110	0.69	6
Perform safety planning tools and techniques	4	10	20	6	108	0.68	8
Perform safety assurance tools and techniques	4	7	22	7	112	0.70	5
Statistical sampling and testing	2	3	25	10	123	0.77	2
Daily or routine inspection	7	6	21	6	106	0.66	10
Defect repair review	8	23	7	1	79	0.51	11
Identifying the process of each activity and how they interact (process mapping)	5	8	21	6	108	0.68	8
Identifying the value added activities using diagram	2	3	25	10	123	0.77	2
Risk management tools and techniques	1	5	7	27	140	0.88	1

To better understand the results of the study a relative index was also used to analyse the level of knowledge about safety control tools and measures. From the analysis the respondents showed that they had a higher knowledge about risk management tools and techniques than any other tool. The second ranked tool was the use of flow charting (identifying the value added activities using diagram). This was ranked second also with statistical sampling and testing. The survey showed that the level of knowledge of defect repair review was very low (RI = 0.51) and was ranked 11th. The survey results also showed that the level of knowledge of daily routine and inspection was quite low (RI = 0.66).

In Haslem et al. (2005) numerous accidents in the construction industry were identified of which the lack of appropriate risk management was a relevant underlying factor. From Table 4.4, Knowledge on risk ranked first but the Level of Usage from Table 4.6, Risk ranked

eleventh (11th). This can related to Haslem et al. (2005) where the study puts across that 84% of the accidents could have been prevented if risk management had been properly carried out.

4.5 LEVEL OF USAGE OF SAFETY CONTROL TOOLS AND TECHNIQUES

The level of usage of safety control tools in the construction industry in Ghana is discussed in this section of the study. To achieve this objective, the surveyed respondents were presented with eleven safety control tools to indicate their level of practice in the operations of the surveyed construction firms in Ghana by choosing from 'Not at all' [1] to 'All the time' [4]. The result of the section is presented in Table 4.4. A relative index was also used to find out the relative weights of each tool.

Table 4.5: Level of Usage of Safety Control Tools and Techniques

Safety Control Measures	1	2	3	4
Safety hazard risk analyses	11(27.5)	26(65.0)	0(0.0)	3(7.5)
Accident investigation	6(15.0)	21(52.5)	8(20.0)	5(12.5)
Process statistical analyses and reporting methods	4(10.0)	8(20.0)	21(52.5)	7(17.5)
Perform safety planning tools and techniques	3(7.5)	8(20.0)	21(52.5)	8(20.0)
Perform safety assurance tools and techniques	5(12.5)	7(17.5)	22(55.0)	6(15.0)
Statistical sampling and testing	0(0.0)	8(20.0)	23(57.5)	9(22.5)
Daily or routine inspection	8(20.0)	20(50.0)	7(17.5)	5(12.5)
Defect repair review	4(10.0)	20(50.0)	9(22.5)	7(17.5)
Identifying the process of each activity and how they interact (process mapping)	6(15.0)	22(55.0)	10(25.0)	2(5.0)
Identifying the value added activities using diagram	2(5.0)	5(12.5)	9(22.5)	24(60.0)
Risk management tools and techniques	26(65.0)	12(30.0)	0(0.0)	2(5.0)

Rank: [1-Not at all, Seldom-2, Frequent-3, All the time-4]

Percentages are in Parentheses, Source: Field Survey, 2014

From Table 4.4, out of the total surveyed respondents of 40 from the sampled construction firms, the majority (65.0%) believe their respective construction companies seldom conduct safety hazard risk analyses. DeVaul (1992) asserts that adequate safety and emergency

preparedness requires considering all of the possible hazards that could be encountered in project cycle. The majority (52.5%) of the surveyed respondents of the sampled construction firms also believed that their respective construction companies seldom conduct accident investigations. DeVaul (1992) believes that companies need to investigate and present reports on the reasons behind accidents since such reports are often required by insurance covering losses. The surveyed companies believe that finding the underlying (or latent, root) cause is the key to preventing similar accidents.

The majority (52.5%) of the surveyed respondents of the sampled construction companies believed that that their respective construction companies frequently use process statistical analyses and reporting methods as safety control tools. Some of the statistical analyses and reporting methods used by the construction companies include collection of data, analysis of the statistical data and reporting of statistical data. According to Hau (1993), process statistical analyses are carried to assess the risk at the various stages of the project. Safety analysis is carried out by a team of experts which as a rule consists designers. The majority (52.5%) of the surveyed respondents believed that their respective sampled companies frequently use safety planning tools and techniques such as practical plans to avoid dangerous occurrences on site. Safety planning involves determining how to approach, plan and execute the requirements for project safety management (DeVaul, 1992). The Safety planning tools employed many construction companies 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 (DeVaul, 1992).

The majority (55.0%) of the surveyed respondents of the sampled construction companies believed that their respective companies frequently employ safety assurance tools and

techniques such as applying safety practices to reduce risks on site. The performance of safety assurance by construction companies involves applying the planned systematic safety activities to ensure that the project employs all processes needed to meet requirements (DeVaul, 1992). The tools employed by the construction companies for this purpose include safety planning tools and techniques, safety audits, safety hazard risk analysis, process analysis, perform safety control tools and techniques, safety management processes tools and techniques.

The majority (57.5%) of the surveyed respondents believed that their respective sampled construction companies frequently conduct statistical sampling and testing as safety control measure. Appropriate sampling can often reduce the cost of quality control. The majority (50.0%) of the surveyed respondents from the sampled construction companies believe that their respective construction companies seldom perform daily or routine inspection and defect repair review as safety control measures. The majority (55.0%) of the surveyed respondents also believe that their respective construction companies seldom identify the process of each activity and how they processes interact (process mapping) as safety control measure. On the other hand, the majority (60.0%) of the surveyed respondents from the sampled construction companies believe that their respective construction companies all the time employ the process of identifying value added activities using diagrams such as flowcharts as a means of safety control. The majority (65.0%) of the surveyed respondents from the sampled construction companies however believe that their respective companies do not employ risk management tools and techniques at all as safety control measure.

Table 4.6 Level of Usage of Safety Control Tools and Techniques

Safety Control Measures	1	2	3	4	Weighting	RI	Rank
Safety hazard risk analyses	11	26	0	3	75	0.47	10
Accident investigation	6	21	8	5	92	0.58	7
Process statistical analyses and reporting methods	4	8	2	7	54	0.64	5
Perform safety planning tools and techniques	3	8	21	8	114	0.71	3
Perform safety assurance tools and techniques	5	7	22	6	109	0.68	4
Statistical sampling and testing	0	8	23	9	121	0.76	2
Daily or routine inspection	8	20	7	5	89	0.56	8
Defect repair review	4	20	9	7	99	0.62	6
Identifying the process of each activity and how they interact (process mapping)	6	22	10	2	88	0.55	9
Identifying the value added activities using diagram	2	5	9	24	135	0.84	1
Risk management tools and techniques	26	12	0	2	58	0.36	11

The level of usage of safety control tools and measures was also analysed to weight the relative level of usage of each tool. The study showed that the use of Flowcharting (identifying the value added activities using diagram) was ranked the highest (RI = 0.84). The second ranked tool was the use of statistical sampling and testing which had a relative importance index of 0.76. It is interesting to note that Risk management tool and techniques was ranked as the lowest tool utilized despite the fact that it was ranked as one of the most known tools. One reason advanced for this could be the lack of formalization of risk management practices in the construction industry. The study also found out that safety hazard risk analysis is not a popular tool in usage. Safety hazard risk analysis plays a pivotal role in accident prevention and the low usage of these tools could be one of the reasons why the Ghanaian construction industry is regarded as one of the accident prone industry (Kheni

et al., 2008). As a result of this it is not surprising that accident investigation is ranked 7th with a relative index of 0.58.

4.6 MEASURES AND STRATEGIES TO IMPROVE SAFETY CONTROL IN THE CONSTRUCTION INDUSTRY

The possible measures and strategies perceived by the surveyed respondents as means of improving safety control in the construction industry in Ghana are discussed in this section of the study. to achieve this objective, the surveyed respondents were presented with 13 measure and strategies of safety control identified in the reviewed literature to indicate their level of agreement to them as possible means for Ghanaian construction companies to improve safety control by choosing from 'Strongly Disagree' [1] to 'Strongly Agree' [4]. The result of the section is presented in Table 4.7

Table 4.7: Measures and Strategies to Improve Safety Control

Measures to Improve Safety Control	Mean	Std. Dev.	Ranking
Employee participation	3.60	0.67	1st
Regular toolbox meetings	3.53	0.55	2nd
Training and education of the work force	3.50	0.51	5th
A clear policy on safety control	3.40	0.48	10th
Well-defined roles and responsibilities	3.45	0.64	5th
Clearly defined goals and objectives	3.40	0.54	8th
Process improvement guidelines and strategies	3.34	0.53	12th
Regular inspections and audits of site safety	3.40	0.50	9th
Incentives for good safety control	3.45	0.55	6th
Good communication and feedback	3.40	0.55	7th
Effective management commitment to safety	3.50	0.68	3rd
Performance monitoring and measurement	3.38	0.54	11th
Compliance to safety control requirements and measures	3.25	0.49	13th

Rank: [1-Strongly Disagree, Disagree-2, Agree-3, Strongly Agree-4]

Source: Field Survey, 2014

From Table 4.7, out of the total surveyed respondents of 40 from the sampled construction companies, the majority strongly agreed to employee participation as a possible means of improving safety control in the construction industry in Ghana as shown by the mean response of 3.60. For instance, the respondents believe the frontline workers should be involved in decision making on product quality. The mean response of 3.53 also implies that the respondents strongly agreed to regular toolbox meetings as a possible strategy of improving safety in the construction industry.

The surveyed respondents also strongly agreed to the training and education of the workforce of the construction companies on safety control measures as means of improving the safety control of the companies as indicated by the mean response of 3.50. the majority of the surveyed respondents also agreed to a clear policy on safety control, a well-defined roles and responsibilities, a clear definition of goals and objectives, process improvement of guidelines and strategies, regular inspections and audits of site safety as possible strategies to improve safety control in the construction industry in Ghana as these measures produced mean responses greater 3.0 but less than 3.50. The mean response of 3.45 implies that the surveyed respondents agreed to the strategy of giving incentives for good safety control as a possible means of enhancing the desire of the construction companies to improve their level safety control. The mean response of 3.40 implies that the surveyed respondents agreed to good communication and feedback within the various levels of working staffs of the companies as a possible strategy to improving safety control.

Effective management commitment to safety is also strongly agreed to by the respondents as a possible strategy of improving safety control in the construction industry as shown by the mean response of 3.50. The mean response of 3.38 implies that the surveyed respondents agreed to performance monitoring and measurement as a strategy for improving safety control in the construction industry. Furthermore, the mean response of 3.25 implies that the

surveyed respondents agreed to compliance to safety control requirements and measures by the construction companies as possible means of improving safety control measures in the construction industry. The suggestions of the surveyed respondents such as management commitment to safety, supervisory safety support, co-worker (safety) support, employee (safety) participation, and competence level as a means of improving safety control measures in the construction industry is consistent with the study of Seo et al. (2004).

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

This chapter mainly focused on key finding of the research problem analysis, measures to be taken in order to improve the sector and conclusion of the study. The recommendations constitute principally managerial level policies.

5.2 SUMMARY OF FINDINGS

This research was set to find answers to the following: 1) What are the Safety Control Tools in the Construction Industry, 2) What is the level of respondent's knowledge of safety control tools in the construction Industry, and 3) what is the level of usage of safety control tools in the construction industry. Rigorous field works was conducted and below are the main findings:

5.2.1 Safety Control Tools and Techniques in the Construction Industry

The major safety control tools and measures revealed to be known to many professionals in the construction industry in Ghana include safety hazard risk analyses, accident investigation, process statistical analyses and reporting methods, performance of safety planning tools and techniques, performance of safety assurance tools and techniques, statistical sampling and testing, daily or routine inspection, defect repair review, identification of the process of each activity and how they interact (process mapping), identification of the value added activities using diagram, and risk management tools and techniques.

5.2.2 Level of Knowledge of Safety Control Tools in the Construction Industry

The study revealed that the professionals in the construction industry have working knowledge about safety control tools such as safety hazard risk analyses, accident investigation, process statistical analyses and reporting methods, use of safety planning tools and techniques, use of safety assurance tools and techniques, statistical sampling and testing, daily or routine inspection, identification of the process of each activity and how they interact (process mapping), and the identification of the value added activities using diagram. However, the studied professionals have limited knowledge about defect repair review but very good knowledge about risk management tools and techniques.

5.2.3 Level of Usage of Safety Control Tools in the Construction Industry

The various safety control tools revealed to be frequently used in the construction industry included process statistical analyses and reporting methods, use of safety planning tools and techniques, employment of safety assurance tools and techniques, and statistical sampling and testing. The safety control tools and measures seldom used in the construction industry however included safety hazard risk analyses, accident investigation, daily or routine inspection, defect repair review, and identifying the process of each activity and how they interact (process mapping). The study also revealed that although the firms in the construction industry employ identification of value added activities using diagram as safety control measure, they hardly employ risk management tools and techniques.

5.2.4 Suggestions to Improve Safety Control in the Construction Industry

The various measures suggested by the surveyed respondents as possible means of improving safety control in the construction industry included employee participation, regular toolbox meetings, training and education of the work force, a clear policy on safety control, well-defined roles and responsibilities, clearly defined goals and objectives, process improvement

guidelines and strategies, regular inspections and audits of site safety, incentives for good safety control, good communication and feedback, effective management commitment to safety, performance monitoring and measurement and compliance to safety control requirements and measures.

5.3 CONCLUSION

Safety control measures and techniques are highly essential to the progress and quality level of products and services rendered by all industries including the construction industry. On this basis, it is imperative for all firms in the construction industry to employ safety control tools and techniques, and also well-equip its professional staffs in the various technical safety control tools necessary in the construction industry. From the result of the current study, it be concluded that the surveyed staffs of firms in the construction industry have working knowledge of many safety control tools including safety hazard risk analyses, accident investigation, process statistical analyses and reporting methods, use of safety planning tools and techniques, use of safety assurance tools and techniques, statistical sampling and testing and many others. However, the surveyed professionals have limited knowledge about defect repair review.

The major safety control tools and measures employed in the construction industry were found to include the process statistical analyses and reporting methods, safety planning tools and techniques, safety assurance tools and techniques, and statistical sampling and testing. The study revealed seldom usage of Safety hazard risk analyses, Accident investigation, Daily or routine inspection, Defect repair review, and process mapping. The construction firms surveyed however bereft of risk management tools and techniques.

5.4 RECOMMENDATIONS

Based on the findings of the study, there is the need to improve the level of knowledge and usage of safety control tools and measure in the construction industry through managerial policies.

5.4.1 Training and Education

The study revealed limited knowledge of the studied professionals on defect repair review as a safety control measure in the construction industry. Therefore, there is the need for adequate training and education of the professionals in the construction industry on the reviewing and repairing of defects.

5.4.2 Risk Management Tools and Techniques Application

Since the study revealed high level of knowledge of the professionals in the construction industry on risk management tools and techniques but seldom applied by the construction firms as safety control measures, it is recommended for the firms to start employing risk management tools and techniques in all aspects of the construction industry.

5.4.3 Employment of Safety Hazard Risk Analyses

The study revealed seldom usage of safety hazard risk analytical measures in the construction industry and so the study recommends safety hazard risk analyses. Critical analysis of hazard risks associated with construction projects and putting in place measure to improve safety could enhance the quality of the projects.

5.4.4 Process Mapping

There is also the need for process mapping which involves the identification of the process of each activity and how they interact. Such process mapping would help identify the risk associated with each process and so put in place to reduce such risk.

5.4.5 Daily Routine Inspection

There is also the need for daily routine inspection of projects for defects and risks. Such daily inspections would tremendously reduce the various forms of hazards in the project sites.

5.5 LIMITATIONS AND DIRECTIONS AREAS FOR FURTHER STUDIES

This study has attempted to make an important contribution to safety control application in the construction industry in Ghana. However, as is the case with most empirical investigations, certain limitations are evident and should be considered when making interpretations and conclusions from the study's findings. Future research regarding this topic can be extended to include other geographical areas, for example, other construction companies in other regions in Ghana. This would therefore assist in the generalisability of the results from the empirical investigation.

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APPENDIX A

Research Survey Questionnaire

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

I am a final year research student from Department of Building Technology, Kwame Nkrumah University of Science and Technology, Kumasi pursuing a post graduate programme in Construction Management. Kindly fill in this short questionnaire, which should take approximately 10 minutes of your valuable time. Response will be completely anonymous; your name or company name will not appear anywhere in any publication. The questionnaire is set up to explore the level of knowledge, the level of usage of the eleven basic safety control tools and techniques by building contractors in Ghana respectively and practical safety control measures required to improve safety on building construction sites.

Your participation in the survey is voluntary and your answer will be kept strictly confidential.

The questionnaire is in **four sections**:

Section A: Particulars of Respondent

Section B: The level of knowledge of safety control tools

Section C: The level of usage of safety control tools

Section D: Safety control measures required to improve safety on construction site

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MSc. Construction Management.

KNUST

If you have any questions, please contact me on

Tel: 0243931414 Email: biggyray7@yahoo.com

SECTION A: PARTICULARS OF RESPONDENTS

Name and address of Company (Optional).....

1. Please indicate the classification of your company

   a) D1K1

   b) D2K2

c) What is your level of education?

   a) Doctorate

   b) Masters

   c) First Degree

   d) Diploma

   e) Certificate

   f) Others (specify).....

g) What is your profession?

   a) Engineering

   b) Building Technology

   c) Safety Management

   d) Construction Project Management

   e) Quantity Surveying

   f) Others (specify).....

g) What is your job position in the company?

   a) Managing Director

   b) Project Manager/Contract Manager

   c) Safety Engineer/Officer

   d) Civil Engineer

   e) Others (specify).....

f) How many years of experience do you have in the construction industry?

a) 0-5 years,

b) 6-10 years

c) 11-15 years

d) 16-20years

e) Over 20years

f) How long has your company been in existence?

a) 0-5 years,

b) 6-10 years

c) 11-15 years

d) 16-20years

e) Over 20years

Does your company have a functional Safety Control Unit / Department? YES ☐NO ☐

SECTION B: SAFETY CONTROL TOOLS

1. Which of the eleven safety control tools do you know about? Please tick appropriately.

Item	*Tool*	*Tick*
1	Safety Hazard Risk Analyses	
2	Accident Investigation	
3	Process statistical analyses and reporting methods e.g. Collection of statistical data, analyse statistical data and reporting of statistical data	
4	Perform Safety Planning Tools and Techniques e.g. Practical plan to avoid dangerous occurrences on site	
5	Perform Safety Assurance Tools and Techniques e.g. Applying safety practices to reduce risks on site	
6	Statistical Sampling and Testing	
7	Daily or routine inspection	
8	Defect Repair Review	
9	Identifying the process of each activity and how they interact (process Mapping)	
10	Identifying the value added activities using diagram e.g. Flowcharts	
11	Risk management tools and Techniques e.g. Strategies used to perform risk identification, risk analyses and responds to risk factors	

SECTION C: LEVEL OF KNOWLEDGE

2. Please express your level of Knowledge about the eleven safety control tools on a scale of 1-4 **1-Not at all, 2- Limited, 3- Working Knowledge, 4 – Very good knowledge**

Item	*Tool*	*Ranking*			
		1	*2*	*3*	*4*
1	Safety Hazard Risk Analyses				
2	Accident Investigation				
3	Process statistical analyses and reporting methods e.g. Collection of statistical data, analyse statistical data and reporting of statistical data				
4	Perform Safety Planning Tools and Techniques e.g. Practical plan to avoid dangerous occurrences on site				
5	Perform Safety Assurance Tools and Techniques e.g. Applying safety practices to reduce risks on site				
6	Statistical Sampling and Testing				
7	Daily or routine inspection				
8	Defect Repair Review				
9	Identifying the process of each activity and how they interact (process Mapping)				
10	Identifying the value added activities using diagram e.g. Flowcharts				
11	Risk management tools and Techniques e.g. Strategies used to perform risk identification, risk analyses and responds to risk factors				

SECTION C: LEVEL OF USAGE

3. Please indicate your level of practice or usage of the eleven safety control tools in your operations on a scale of 1- 4. **1- Not at all, 2-Seldom, 3-Frequent, 4- All the time**

Item	*Tool*	*Ranking*			
		1	*2*	*3*	*4*
1	Safety Hazard Risk Analyses				
2	Accident Investigation				
3	Process statistical analyses and reporting methods e.g. Collection of statistical data, analyse statistical data and reporting of statistical data				
4	Perform Safety Planning Tools and Techniques e.g. Practical plan to avoid dangerous occurrences on site				
5	Perform Safety Assurance Tools and Techniques e.g. Applying safety practices to reduce risks on site				
6	Statistical Sampling and Testing				
7	Daily or routine inspection				
8	Defect Repair Review				
9	Identifying the process of each activity and how they interact (process Mapping)				
10	Identifying the value added activities using diagram e.g. Flowcharts				
11	Risk management tools and Techniques e.g. Strategies used to perform risk identification, risk analyses and responds to risk factors				

SECTION D: WAYS OF IMPROVEMENT

4. What practical measures would you suggest to improve safety control?

Please indicate on a scale of 1-4. **1- Strongly agree, 2- Agree, 3- Disagree, 4 – Strongly disagree**

Item	*Measures*	*Ranking*			
		1	*2*	*3*	*4*
1	Employee participation- Frontline workers participation in decision making on product quality				
2	Regular toolbox meetings				
3	Training and education of the work force				
4	A clear policy on safety control				
5	Well-defined roles and responsibilities				
6	Clearly defined goals and objectives				
7	Process improvement guidelines and strategies				
8	Regular inspections and audits of site safety				
9	Incentives for good safety control				
10	Good communication and feedback				
11	Effective Management commitment to Safety				
12	Performance monitoring and measurement				
13	Compliance to safety control requirements and measures				

2. Any other recommendation on how safety control can be improved in the construction industry? Please suggest

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Thank You