KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,

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

BY

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DECLARATION

I hereby declare that this submission is my own work towards the Master of Science (Construction Management) and that, to the best of my knowledge, it contains no materials previously published by another person nor material which has been accepted for the award of any other degree of the university, except where due acknowledgement has been made in the text.

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ABSTRACT

The daily report on accidents and death issues in the Ghanaian construction industry is worrying. This has a major cost implication on the construction industry in Ghana as well as on the economy of the nation. It is for these reasons that this report sought to identify ways to improve upon safety planning and implementation by contractors in Ghana. This was done by first exploring the level of knowledge of the Ghanaian contractors on safety tools and techniques as well as the level of usage of these tools. To do this, a questionnaire survey was carried out on 40 contractors in the Upper East Region. The 40 contractors were selected through purposive sampling. The survey revealed that the level of knowledge and usage of the following tools and techniques in safety planning was quite high: Cost benefit analysis, Benchmarking, Trails and simulation, Flowcharting and Process mapping. Contractors however suggested the following as points to improve upon safety planning: Employee involvement in safety planning, all information on hazardous substance should be registered and assessed in a central catalog, Contractor‟s current and past safety performance history should be examined. However, it was observed that project safety requirement review and risk management process tools and techniques were not employed by most contractors. Therefore it is recommended that contractors should review project to identify risky areas and plan towards reducing or eliminating these risk, regular and strict supervisions should be carried out by the authorities in the required institutions of health and safety, and also contractors should review projects to identify the residual risk so as to consider them in future projects.

DEDICATION

This project is dedicated to Alden Akurugo and Anslem Akurugo

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CHAPTER ONE

INTRODUTION

1.1 BACKGROUND OF STUDY

Some of the participants of construction projects include the designer, contractor, project managers, owners and other professionals of the construction related industries. Every participant ensures the implementation of safety in construction related projects. Due to the more complex and technical nature of construction projects, much efforts are needed to mitigate or eliminate and improve safety on the construction projects site (Abdelhamid & Everett, 2002).

Application of safety planning tools and techniques in construction project has a great influence on the cost-effectiveness and achieving successful project performance (Harris & McCaffer, 2001). Safety planning tools and techniques enhances project planning, implementation and then monitoring and control of a project.

A construction safety plan is a document that details the safety precautions that will be considered during specific projects (Harris & McCaffer, 2001). Many companies have safety plans sitting in books; they will update these plans to meet requirements of each project. The construction safety plan is important for many reasons. One, it helps give protection to workers and the general public from danger, injury or harm. Two, it is often required that clients or developers assist reduce their liability while the job goes on. Finally, many insurance companies require safety plan before insuring a job or project.

Accidents that result in worker injury and death are as a result of poor safety planning by contractors (Abdelhamid & Everett, 2002).

Therefore the need for effective safety planning, which is very critical in controlling of accidents on project site. It is also important that safety planning should be critically taken into account by contractors or parties on a project. Regular safety meetings, training, education and thorough inspections are very crucial. This helps the parties concerned in a project to be aware of the progress of safe working conditions that are on site.

Proposals submitted by sub-contractors in order to undertake sub-works should agree with safety plan presented by the contractor (Sengupta,1999). stated that prevention of accidents on construction site is a matter of education, training co-operation, vigilance and effective safety planning.

1.2 PROBLEM STATEMENT

Construction participants namely project managers, contractors, domestic and nominated subcontractors, architects, safety officers and safety designers and the owners need to be informed of safety planning in construction projects. This will ensure that construction accidents will be minimized through information, planning, forecast and implementation of safe construction practices on every job site.

Safe practices in construction projects results in safe construction site. This helps to curb accidents. Also, safety planning of construction contributes to a more professional work environment, leading to an improved excellence work with less delay (Lingard et al., 2005). The construction business is characteristically risky, with a substantial number of accidents and disasters happening, predominantly on restricted construction sites (Sengupta, 1999). (Armstrong, 2006), thousands of people are killed at construction sites yearly and hundreds of thousands more are incapacitated or suffer ill

fitness. The causes of these accidents can be attributed to a lot of factors, some of which are lack of supervision, lack of operator visibility and skill, etc. One major cause of these accidents is the absence of proper safety planning. This has given me the motivation to carry out this study to ascertain whether contractors were aware of these tools and if they are used by used by constructors on site.

1.3 AIM AND OBJECTIVES

This study sought to suggest practical measures to improve on safety planning by contractors in Ghana, by exploring the level of knowledge and usage of existing tools and techniques.

To achieve the research aim stated, the following objectives are set;

- To assess the level of knowledge of contractors on safety planning tools and techniques.
- To assess the level of usage of safety planning tools and techniques by contractors.
- To identify practical measures to improve safety planning by contractors.

1.4 SIGNIFICANCE OF THE STUDY

Safety is important on all construction-related project site, for several reasons such as protecting the welfare of workers, guaranteeing a safe work environment, equipment of contractors and monitoring construction costs. Yet, the significance of being informed and making use of safety planning tools and techniques is frequently ignored by clients and contractors. As a way of mitigating the risks related to construction, safety can meaningfully impact on the total cost. A dedicated commitment to safety planning by both the client and contractor assist in ensuring project realization (Pfeffer, 1998).

1.5 RESEARCH METHODOLOGY

To understand the statistics used in this investigation, the researcher need to gather data and this data is generated out of research, therefore, there is the need for the researcher to use tools to help answer research questions (methodology) that would ensure a reliable data in safety planning.

- To assess the level of knowledge of contractors on safety planning tools and techniques.
- -To assess the level of usage of safety planning tools techniques by contractors.
- -To identify practical measures to improve safety planning by contractors.

Questionnaires were administered to civil engineers, project managers, managing directors, safety officers etc. on site, in other to explore their knowledge on the tools and techniques identified from literature.

1.6 SCOPE

This study focused on D1K1, D2K2 contractors. This is because they form majority of registered contractors working on projects in Upper East Region, which is the youngest region after Upper West Region, in Ghana. This area was also chosen due to low rate of growth in the construction industry in this area evident in its infrastructure gap/deficit.

1.7 STUDY LIMITATION

There were missing values on some of the questionnaires, for instance with job position five percent failed to indicate their job position.

1.8 ORGANISATION OF REPORT

The research is organized in five (5) chapters by way of:

- Introduction
- Literature review.
- Research methodology and design
- Results, analysis, discussions of findings or results
- Conclusions recommendations

Chapter one deals with an outline of the research. The chapter covers background of the research area, the research problem, research aims and objectives and the methodology.

Chapter two addresses a discussion of literature related to the project title. This chapter provides the information to achieve the objective of the study. The relevant information includes conscious effort about safety management, safety planning and safety planning tools and techniques.

Chapter three detail with the methodology that was employed in conducting the research; the design and methods used for data gathering as well as steps adapted in analyzing data gathered.

Chapter four indicates the findings of the research. Data is analyzed and discussed in this chapter.

Chapter five presents a summary of the outcome /findings of the research for conclusions as well as recommendations intended for further studies.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Review of literature on construction safety planning indicates that considerable research energy has been focused at exploring accident records to classify the most common types of accidents that frequently occur to particular activity or trade, and how these accidents do occur (Culver et al., 1990). In addition the topic of safety planning has been covered from different perspectives. (Amoako, 2008). Focused on the relevance of construction safety professions in the construction sector and what measures these professionals can undertake to minimize site accidents, (Hinze, et al.,

2008) identified causes of construction accidents and injuries. In addition, (Khani, 2008) investigated in to issues regarding site accidents and its possible causes and how these accidents could be well managed and others studied various aspects of construction personnel‟s' health and safety, (Armstrong, 2006). Influence of design on safety planning during construction stage, performance approach to health safety management in construction.

2.1.1 Significance of the construction industry

Construction is a basic activity through which we shape our environment to better fit our needs. The construction sector satisfies also other needs indirectly, for example, stores, factories and warehouses are constructed to give manufacturing space and places to store and sell clothing. Food processing plants are constructed that make it possible to process large quantities of food in short periods of time. This helps us keep up with the ever- increasing demand for food. Once the food is processed, it is stored and sold in buildings that have been constructed for that purpose (Ofori,1990).

2.1.2 The role of the construction industry in world's economy

The construction industry plays a very significant role in any economy. Example is, a study done by (Lopes, 1998), which indicates that, countries which invested at least of 4% in the construction sector are expected to grow quicker in Gross Domestic Product (GDP). Yield from construction sector is a key and forms core part of the national output, accounting for a significant proportion in the Gross Domestic Product (GDP) of developed and developing countries (Crosthwaite, 2000). (Lowe, 2003) specified that value contributed by construction is in the ranges of 7% to10% for very developed economies and a region of 3% to 6% for developing economies. The construction outputs can be categorized as a core component in investments and part of fixed capital. They are both very important factors for an uninterrupted economic progress. Product of construction need a long period for development and is likely to supply services for some time. Investments in construction assume main significance because any development in the economy needs infrastructure investments as necessity to potential economic progress (Ive & Gruneberg, 2000).

The construction industry is often used by government to control the local/national economy. For instance, when it is downturn and the number of joblessness is high, government uses the construction segment to step-up the public outflow, thus the complete way in which the construction segment interrelates with the national/local economy and wealth of people included is not well comprehensible. The construction industry has substantial relations with other economic sectors as a regressive and accelerative relationship (Ganesan, 2000). The regressive linkages show the relationship of inter - industry procurements aggregate input, while the accelerative linkages show the relationships of inter-industry sales to aggregate output. These

reviewed literatures clearly show the influence of the construction industry to world economy. In the new developing countries like Vietnam, construction industry is the driving force of the economy. The industrial sector and construction can contribute to about 43% to GDP, according to the national report, In terms of employment, the US construction industry contributes to about 5.1% of employment, and in UK it is 7% of employment.

2.1.3 The role of the construction industry in the Ghanaian economy.

In Ghana, just like any developing country, the construction industry significantly contributes directly and indirectly to the macro and micro economy. For instance, the industry has regularly contributed an average GDP growth range of 6.1% to the economy as at 2003 to 2008. Indeed, the industry in Ghana was the about the third major growing economic sector overtaking the manufacturing industry in 2004 with a continuous GDP growth range of 5.8 % in 2004 to 2005. This remarkably steady growth increased to 6.1 % in2006. In 2007, it had increased up again from 6.2% and peaked at 7.3% in 2008 (ISSER, 2005, IMF, 2009, DI, 2009). A research by (Kheni, 2008) shows that there are serious problems concerning health and safety practices with regards to SMEs construction companies. Among the problems inadequate skilled human resource, insufficient support from the government towards regulatory institutions and ineffectiveness in institutions required to ensure health and safety standards. In addition to the problems indicated was the essence of the Ghanaian socio-cultural value systems especially the extended family system and traditional religious value systems so far as health and safety administration in SMEs in Ghana is concerned. His study also highlighted the difficulties caused by the internal environment of SMEs to the efficient administration of health and safety. (Kheni, 2008) offers a wide understanding of health

and safety in the construction sector in Ghana. (Laryea, 2010) also studied the condition of health and safety on construction sites in Ghana. They used first hand observation of fourteen (14) construction project sites in 2009 and 2010. The outcome shows a poor condition of health and safety on Ghanaian construction sites.

This shows that the industry has a huge potential of leading the way for the economic development of developing countries such as Ghana if well exploited. However, despite this strategic importance of the construction industry to the world economy and the economy of Ghana, it is fraught with occupational health and safety issues. Lots of accidents, disasters, health disorders and disease which claim a number of human lives are associated with this industry. For instance, it was stated that the construction industry, recorded 902 accident cases comprising 56 fatal accidents in

2000 and 846 non-fatal accidents, these accidents which claim lots of worker life"s on site can be monitored and controlled by ensuring safety planning. The adaptation and effective safety planning on site reduces the occurrence of accidents on sites. Health and Safety issues are not only confined to the construction phase of a project, but occur throughout a project or facility"s life (Amoako, 2008).

The route to site safety is through effective safety planning .In order to study safety planning.

2.2 SAFETY CHALLENGES ON CONSTRUCTION SITE.

Though accidents instigated by the uncertain environment may not be easily avoided, it is however possible to control and progress current safety administration to defend workers from artificial work related hazards by inspiring positive employee behaviour

(e.g., avoidance of premature acts, awareness of safety work) driven by an effective administration system (Krause, 1993).

(Bottani et al., 2009). Linked human performance with safety. Studies have agreed with this assertion (Hillebrandt, 2000). Errors made by humans are one of the key underlying causes of industrialized accidents, and the fundamental component of various safety problems in high risk facilities (Hillebrandt, 2000). Various theories have been propounded for this. For example (Hinze‟s, 1996) Distraction Theory point out that workers who are distracted by physical hazards or mental diversions are at higher risk of accidents. Another school of thought has recognized the accident causation Theory, which pinpoints the importance in error identification on averting accident, production rehearses can avert production errors. Hence, it is asserted that safety practices can help avert human errors and thus lessen the possibility of accidents if these practices are shaped by the guiding principle and focusing on circumventing construction mistakes and rework (Suraji et al., 2001).

2.3 Established roles/responsibilities of safety planning team

On site of construction, managers / foremen are the most noticeable front-runners and are observed by the employees as visible „face‟ of the corporation. It is leaders with ability and control who are able to influence the desired behaviors necessary for a safe environment by reinforcement of the organization‟s safety standards. (Wentz, 1998) says that organization should inspire and support safety by providing a good safety illustration; efficiently managing health and safety programmed, going for health and safety conferences, carrying out checks, examining near-miss accidents and revising safety performance at all levels. Construction health and safety must be of principal concern to employers, employees, governments and project members (Kheni, 2008).

Thus the main participants in charge of construction health and safety are the client, main contractor, statutory institutions and agencies and employees.

2.3.1 Employers; in developing countries, employers have the responsibility for taking methods to mitigate health and safety risks at work. This has however shown an intimidating task for numerous employers, especially in owner/managers of construction. Apart from the fact that the special characteristics of the industry makes the risks of accidents and ill-health very high, the structure of work and physical conditions in developing countries increase the health and safety difficulties.

2.3.2 Client; employs the qualified people, permit sufficient time, disseminate information to building team, Ensure that team communicates and co-operates, Ensure suitable management provisions are in place. Provide satisfactory welfare facilities on site, provide workplaces that are designed appropriately, and hire a principal contractor, Ensure a health and safety plan is in place, Keep the health and safety file and protecting the public.

2.3.3 Contractors; Provide safe access on site, Working at height safety precautions, Safe scaffolds, Safe excavations, Safe ladders, Safe loading and unloading of goods, harmless transportation, vehicles and plant, Safe tools and machinery, Safe hoists and cranes, Safe emergency measures, Safe storage, treatment and disposal of dangerous substances, Protecting the public.

2.3.4 Employees; Wearing of Personal Protective Equipment‟s, Take care of equipment and Report any defects.

2.3.5 Regulatory agencies; Theses regulatory bodies ensure that all safety requirements of a project are implemented and also provide Guidance notes, Safety alerts, Health and safety education Enforcement, Health and safety.

2.3.6 Project manager; Determine labour requirement, clearly understand and elucidate, contract terms to staff, employees, and clients Make contracts and negotiate revisions, variations and add-ons to contractual engagements with architect, consultants, clients, procurement officers and subcontractors. Obtain all necessary permits and license.

2.4 SAFETY MANAGEMENT

Construction safety management as a discipline is applied to many aspects in construction from start to finish of a project. Professional construction managers seek to address the needs of client by providing management services and expertise necessary to the project, a comprehensive project controls measures are used to address critical issues of time, scope, cost, quality, and most essentially Safety management, Safety management is an administrative task, which ensures that all safety risks associated to a project have been identified, assessed and mitigated, this can be done through safety planning, safety assurance and safety control. Safety management in the construction industry is to prevent human injury or loss of life, and to avoid damage to the environment the construction industry suffer from an overall failure to manage workshop health and safety to a state where an achieved upgrading in safety performance by a way of pro-active measures can result in accidents free The management of health and safety in developing countries is founded on the existence of regulatory frameworks which requires that workplaces to be harmless and institutional structures be set-up to enforce the law. Employers are to ensure that workplaces are free

of hazards injurious to the health of their workers and other persons whose health may be harmfully affected by the processes of the business.

Krause (1993) said that events occur downstream of principles (purpose, task, standards, goals, expectations), administration system and exposure. Krause sustains that employee behavior is a direct outcome of management system and is the ultimate common pathway of most incidents. Management system in turn is influenced by the organization culture which has a substantial influence on the allocation of resources to health and safety.

Thus, construction site safety is regarded here as a reflection of the three elements recognized by Krause, as adopted and promoted by the management of contracting organizations to directly or indirectly enhance the safety of individuals on the project site. This definition is adopted as the process of site safety management is usually managed reactively and is the sole responsibility of the contracting organization (Hinze, 1996).

2.4.1 Safety planning

The PMBOK guide defines practices for safety planning. This includes determining the applicable requirements that determine the measures that will be used to determine both the suitability of a project management system in fulfilling the necessities of the project and the ultimate acceptance of the product or project. The guide also adds assessing how best to apply the applicable acceptance criteria, documenting their characteristics and associated risks, and determining how to satisfy them, Lastly determining how the appropriateness and efficiency of project safety management will be weighed or determined (PMI, 2007).

2.4.2 Safety assurance

Safety management practice refers to an established work-related means that support to prevent and considerably reduces accidents at workplace (Cheng et al., 2012).

Safety awareness and its subsequent effect on injury and illness rates can be enhanced by increasing support to safety management (Krause, 1993). Safety assurance in construction includes all planned and orderly process necessary to provide assurance that the facility will execute accordingly. Safety assurance in construction seek to address the difficult of having the safety of the project to be constructed in the high efficient, economical, and acceptable manner, Within this wide setting, safety assurance comprises continued review of planning, design, development of plans and stipulations, publicizing and awarding of contracts (Cheng et al,2012).

Safety assurance on construction projects requires that processes for incorporating design changes to construction plans be properly developed and utilized fully. When design changes are recognized and implemented earlier the lower the risk. Safety assurance in construction must monitor how well management of the design, and change of design processes are functioning. These represent the safety issues that must be monitored throughout the safety assurance effort and acceptance testing (Suraji et al., 2001).

2.4.3 Safety control

The PMBOK Guide provides that safety control involves knowing and applying measure for monitoring the achievement of specific project results throughout the project to determine whether they comply with the safety requirements (PMI, 2007). Classifying unsatisfactory performance and identifying ways to eliminate causes of

unsatisfactory safety performance. This includes failures on the part of safety planning and safety assurance, Safety control in the construction procedure is extremely important in order to ensure that there value of money for the investment made. Process personnel of safety control can perform checks and tests throughout the construction process to ensure safety, providing the project client safety assurance that the project is being constructed according to plan and specifications (Suraji et al., 2001).

2.5 SAFETY PLANNING

Safety planning plays key roles in construction project management for reducing and controlling cost and delays due to accidents. Safety planning ensures that safety is at all-time taken into account along with quality, cost schedules, and other important project goals. Safety planning includes identification of possible hazards and hazardous activities and ensuring safety measures, safety planning can be enhanced into safety management system by including more tasks, identification of safety hazards, classification of hazards, hazard control and monitoring the implementation.

Among these tasks, hazard identification is the most important, since failure to identify the hazard will lead improper safety planning measures (Garvey,2008).safety planning, This includes determining the applicable requirements which outline the criteria that will be engaged to determine the appropriateness of a project management system in fulfilling the requirement of the project and the final acceptance of this or project. The guide also adds calculating how best to apply the applicable acceptance criteria, documenting their features and associated risks, and determining how to fulfill them, Lastly determining the appropriateness and effectiveness of project safety management will be measured (PMI, 2007). The contract for any construction work involve is the principle project safety standard, as it will specify the applicable safety statutory and

legislative requirements, technical safety codes, standards and regulations. Safety planning tools include Cost benefit analyses, benchmarking, trials and simulations, cost of safety, also, planning tools for safety are flowcharting, process mapping and project safety requirements review and risk management processes tools and techniques, in construction, planning can cover a whole number of activities ranging from pre-project planning, through design, to planning specific site activities (PMI, 2007). It is projected that about 90 per cent of accidents might be prevented through healthier planning before work starts (HSE, 1998). Other recent studies have established that planning and control failures were related to 45.4 per cent of accidents (Duff and Suraji, 2000). And designers could have added to the prevention of about 47 per cent of accidents explored as part of an H SE study project (HSE, 2003). Efficient planning for Health and Safety is thus essential if projects are to be executed on time, without cost overrun, without experiencing accidents leading to damaging the surroundings or the health of site personnel (Teo et al., 2005).

2.5.1 Safety planning inputs

These are factor that are well considered in safety planning, includes:

- **Enterprise environmental factors**; are those environmental related factors which are either within, outside or both internal and external of the project and can have serious impact on the project. These factors can have negative or positive influence on the project, project environmental factors may include the following: culture and type of structure of the ongoing project processes or standards, project specific processes or steps in carrying out certain activities in certain ways, government and industry standards that must be observed or followed, project guidelines for hiring and performance reviews, facilities and

equipment available to perform the project, human resources needed or available to the project, such as skills and expertise, project stakeholder‟s requirement, marketplace conditions relevant to the project, and political influence or climate (Cheng et al,2012).

- **Organizational process assets**, They are process-related assets of any project or organizations involved in the management of a project that can be used in influencing the project to meeting its specific requirement. Organizational process assets are typically grouped into two classifications: Processes and procedures for performing activities, and corporate knowledge base for keeping and retrieving the information when needed, the performing project may have its policies, procedures, and techniques; whose influence on the various projects must be cared for while emerging a project charter and other documents of the project. Another instance of organization process assets are the knowledge and learning base, learnt from earlier projects (Hinze,1996).

- **Project management plan**, these are document covering the whole project of the entire phases of planning, from initiation through planning, execution and closure. All-inclusive plan should have at least the followings constituents Scope, Schedule, Communication, Risks, Procurements, Costs, Quality, Project team Changes and Closure. In writing project management plan, the methodology depends on the nature of the project and it context of Safety policy (Kheni, 2008).

- **Safety policy** is an area concerned with the safety, health and welfare of individuals involved in an occupation. The purpose of occupational safety programs is to provide an accident free or safe and healthy work atmosphere,

the policy therefore provides a parameter for the project and workforce and also to provide protection for family members, clients, and the numerous persons who might be affected through the workplace environment (Rowlinson, 2004).

- **Project stakeholder requirements**, successful projects are delivered base project specifics or requirements, stakeholder expectations and functional requirements. However this can be done when working with the client, management and users of the projects.(Saurin et al,2004).

2.5.2 Safety planning tools and techniques

Cost benefit analysis, simply refer to monetary or safety valuation of the risk of carrying out a task and the benefit of performing that task, in a certain manner. One illustration is the wearing of gloves in carrying out maintenance of a mechanical saw. So what is the risk of not wearing gloves? What would be the benefits of wearing gloves? Maintenance operative may contact saw blade when performing maintenance work and injury themselves. Gloves will protect the maintenance operative from cuts, nonetheless the gloves may also obstruct the rate maintenance and also access to small parts within the machine, thereby making it more difficult. Cost-Benefit Analysis can be used in situations. Example, when you are: Determining whether to hire a plant or new project management team. Determining the feasibility of a project capital purchase. Accessing a new project or changing initiative.

However, Cost Benefit Analysis is one quick tool in decision making and simple financial decisions (Cheng et al,2012).

Benchmarking is a practice of enhancing performance by always understanding, recognizing and adapting the best practices and processes set up within and outside a firm.

Benchmarking seeks to improvement of commerce process by exploiting very best practices rather than gauging of best performance. Best practices are the output of best performance.

The orderly discipline of benchmarking is focused on identifying, studying, analyzing, and adapting the best practices and implementing the results. To regularly get the maximum value from the benchmarking process, senior management may discover the need for a significant culture change. That change, however, unleashes benchmarking potential to create large paybacks and strategic advantage (PMI,2007). The benchmarking process involves comparing one‟s firm performance on a set of measurable parameters of strategic importance against that of firms‟ known to have achieved best performance on those indicators. Development of benchmarks is an iterative and on-going process that is likely to involve sharing information with other organizations working with them towards an agreeable metrology.

Benchmarking shall be seen as a tool for improvement in a wider scope of customer focused improvement activities and should be driven by customer and internal organization needs.

An objective of benchmarking consist of sourcing information from a firm to beneficially apply it to another firm. The scope aim at improving the processes performed at the recipient firm by applying effective and efficient work processes; it is a valuable engineering technique (PMI,2008).

Flowcharting is a tool use for examining processes. It is breaking down of any process, down into individual events or activities and to display these in shorthand form showing the logical relationships between them. Fashioning out flowcharts allow for a clearer understanding of processes, and an improved understanding of processes is a pre-requisite for improvement.

Flowcharting is use to develop understanding of how a process is done, to study a process for improvement, to communicate to others how a process is done, when better communication is needed between people involved with the same process , to document a process and when planning a project (PMI,2008).

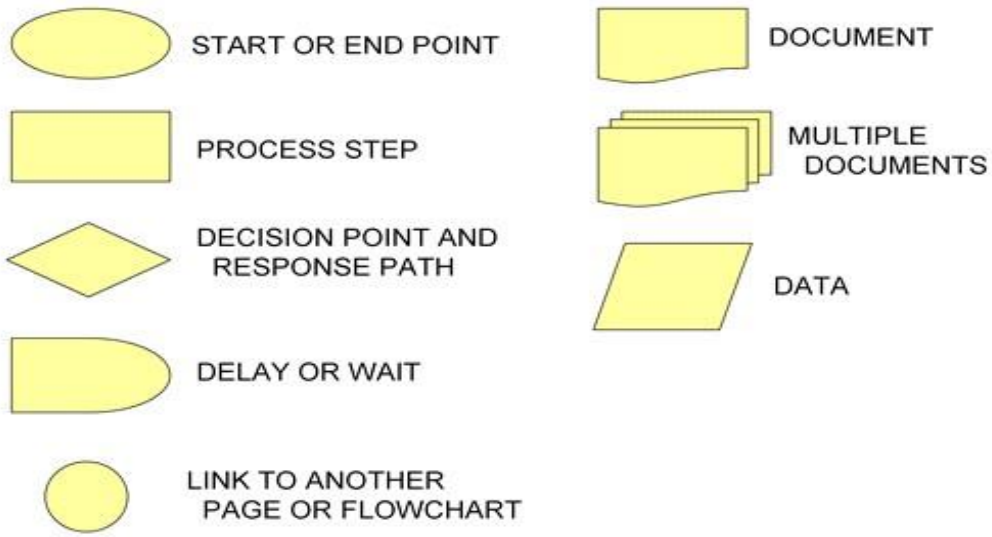

Figure 2.1 Flowcharting symbols Source: dmaictool.

Cost of safety, The significance of safety as a cost monitoring measure is often ignored by owners and contractors. As a means of decreasing the risks related with construction,

safety can significantly impact the overall cost. A dedicated commitment to safety by both the owner and contractor helps ensure project success and can impact the bottom-line considerably (Ofori, 1990)

Process mapping, is a tool to visually that shows how a project work flows and as a communication tool a safety planning tool and a tool that assist in the management of construction firms, key in this process include, Inputs, Outputs, Activity steps, Decision points, Functions, The process map have lines and symbols help in recording concise sentences for every stage of these processes (PMBOK,2008).

Purpose of process mapping: is for a clear understanding of the process. It involves the gathering of facts of work and outlining them to be questioned and improved by people expertise, it can be done using visual charting symbols consistently (PMBOK, 2008).

Risk Management Process Tools; include planning, implementation, and progress monitoring. As part of the iterative process, the risk management tool is used to record the outcome of risk prioritization analysis that provides input to risk mitigation and risk impact assessment risk mitigation strategies guidelines for applying risk mitigation management options ,these choices are based on the combination of the likelihood of occurrence and severity of the consequence for an identified risk. These guidelines are appropriate for many, but not all, projects and programs (Garvey,2008).

Project safety review, the construction projects should review and improve its safety management activities continuously to enable its overall safety performance improves constantly, using relevant experience from previous project, a systematic review of performance according to data available from review. Monitoring and from

selfdetermining audits of the whole safety and health management system. These form the basis of complying with the firm responsibilities and other statutory provisions. There should be a strong commitment to uninterrupted improvement including the development of policies, schemes and techniques of risk control, Data from this „appraising and reviewing performance" process should can be used for this purpose (Kossiakoff, 2003).

2.5.3 Safety planning out put

These are the outcomes of safety planning, outlining the safety measure that should be adopted in performing a particular activity.

Safety Management plan; These are measures and personnel who are designated to take care of safety on site, the must be dedicated safety representative, this personnel is to promote safety on the project site and ensure a safety practices for personnel"s on the project site, record activities on the Safety Activity Monitoring Register (Behm,2005).

Emergency Plan; The case of a site emergency, Emergency evacuation alarm will be broadcasted and employees must quickly vacate project site. The site management team will announce a common assembly point at the time of your orientation onto the project site, emergency plan increase safety awareness and shows an organization's commitment to the practices of safety of workers, an emergency plan outlines procedures for handling the unexpected cases. The reason is to be prepared to: Prevent injuries, Reduce damage to buildings, and equipment, Protect the environment and to ensure normal operations (Behm,2005).

Safety metrics; are extremely important in safety improvement and project quality. Metrics are measures which enable the project management team to assess various performance parameters of an activity. These measures allow the team to monitor continuously, measure, and track performance to form the bases to determine the efficiency and effectiveness of an activity (Hinze,1996).

Safety Checklist, in construction Safety, a checklist is a tool for contractors, project managers, safety officers and many others to help them in identifying the tasks, hazards, and controls, according to their scope of work, and to properly ensure safety on site (Hinze,1996).

Construction safety & health issues (Safety Checklist)

1 .General housekeeping is neat and orderly?

2. Safety equipment‟s are openly available to all employees?

3. Concrete work? Silica dust training documented for all?

4. All hazardous containers labeled appropriately?

5. Lockout/Tag out is being used for appropriate tasks?

6 .Hot work permits used for grinding, cutting, welding?

Process Improvement Plan, are procedures that examine an activity or processes with the aim of improving upon the process. The following are considered in Process Improvement Planning, process boundaries, process metrics and targets for improved performance (Kheni,2008).

Safety zone signage, workers for the highway, trenches, mines and many others are exposed to hazards from external and internal of the work zone. Falls, struck-by, and

caught between are the most common hazards in this type of works. Therefore the setup for visual signage should be properly done by safety department (Behm,2005).

2.6 CHAPTER SUMMARY

Construction is a basic activity through which we shape our environment to better fit our needs, this chapter focused on the relevance of construction safety professions in the construction sector and what measures these professionals can undertake to minimize site accidents, the challenges of health and safety management, safety planning and other through literature review.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter discusses the research methodology adopted for the study to answer the research questions raised in order to achieve the research aims and objectives. Methodology normally discusses the techniques that are employed in conducting research. This comprise data gathering through the use of research tools or instruments such as questionnaires, interviews, observation as well as sampling steps and statistical techniques to bring together facts leading to understanding of unstructured data (Bryman, 1992). The methodology presented in this chapter involves the research paradigm, research design, population sampling, sampling procedure, data collection approaches, issues of confidentiality, the validity and reliability of the study as well as an overview of the methods used in the data analysis (Burns & Grove, 1987). The methodology consist of the design, setting, sample, methodological limitation, data collection and analysis techniques in a study. It is the know-how of the scientific methods and practices employed to obtain the valid knowledge. Thus research is the

way through which we gain knowledge about the world, trying to discover how we can go about the task of finding out what we believe to be true (Christou *et al.,* 2008).

3.2 RESEARCH PARADIGM

This study was triangulated, thus it employed both quantitative and qualitative research approach. The easy way of distinguishing between qualitative and quantitative research technique may be to say that qualitative methods involve a researcher recounting varieties of characteristics of people and events without matching events in terms of measurements or amounts. Quantitative methods, on the other hand, focus attention on measurements and amounts (more and less, larger and smaller, often and seldom, similar and different) of the characteristics displayed by the people and events that the researcher studied.

3.3 RESEARCH DESIGN

Research designs consist of three collective methods, the exploratory, descriptive and the explanatory research designs. Exploratory research is developed built on grounded theory which was planned as a flexible approach to formulate theory based upon generic principles of theoretical saturation and constant comparison method of analysis (Glaser and Straus, 1967). The exploratory research design seeks to explore the special nature of a problem (Saunders *et al.*, 2009). However, when using the descriptive research, the goal is to disclose an accurate profile of events, persons or situations. The descriptive research can be related to both an extended version of exploratory and a piece of explanatory research design (Punch, 2000). Explanatory study is the last study. The explanatory design creates connection between studies and variables, meaning that the

objective is to study situations, trying to find an association between variables (*ibid*). However, this research focused more on the descriptive and exploratory aspects.

3.4 POPULATION AND SAMPLING PROCEDURES

This section considers the population of the study, the sample size and the sampling technique.

The population of any research is made up of the individual units or an aggregate, that is the unit or the individuals that form the population whereas a sample is a section of the population selected randomly or otherwise to represent the population (Punch, 2000). This study sought to suggest practical measures to improve on safety planning by contractors in Ghana with emphasis on contractors in the Upper East Region of Ghana. The population includes civil engineers, project managers, managing directors and safety officers of the construction firms involved in the study. The sample comprised 40 professionals in the construction firms.

3.4.1 Sampling Techniques

According to (Saunders *et al.* 2009), purposive sampling enables the researcher to choose the population that will best assist the researcher to respond to research question(s) and to meet the research objectives. This form of sampling technique was used due to the small sample size and particularly informative in meeting the research objective. Purposive sampling also increases the probability that variability common in this social occurrence would be represented in the data. The purposive sampling technique is a non-probability sampling method which involves the conscious selection of certain subjects to be included in the study (Polit & Hungler, 1999).

The purposive sampling technique was used in identifying the key respondents, namely civil engineers, project managers, managing directors and safety officers of the construction firms involved in the study, this was because the researcher required certain categories of respondents who would have had experiences in construction related safety issues to answer the questionnaires. Using the purposive sampling technique in selecting project managers and other respondents from well-known and reputable construction firms from the upper east region were considered since the researcher believed that they were representative enough to the population of interest and could give practical and satisfactory answers to the questions asked.

3.5 Sources of Data

Data for this study was gathered from both primary and secondary sources. The administration of questionnaires forms the basis of the primary data. Data from this source would focus on the background characteristics of respondents and their knowledge on safety planning tools and techniques, their usage of safety planning tools and techniques and suggestion of practical measures to improve safety planning among Ghanaian contractors. The secondary data (literature review) was extracted from documented facts using plain sheets and other relevant materials. The data extracted from literature formed the theoretical framework for the research. Both direct and indirect sources provided the data and was used to support the primary data.

3.6 Data Collection Method

Primary data was collected and used for the research. A questionnaire was developed to elicit information on the perceptions of safety planning tools and techniques among Ghanaian contractors. The items were divided according to the objective of the research.

A close-ended structured questionnaire was used for the data collection. The content of the questionnaire was clear and easy to understand. The layout made it easy to read and at the same time pleasant to the eye with a carefully designed sequence that made it easier to follow. Questionnaires were personally administered to the respondents and were retrieved by researcher. Questionnaires were used because data collected using questionnaires can be stable, constant with uniform measure without variation, Thus reducing biase.

3.7 Pilot testing of data collection instruments

Pre-testing activity of the data gathering instruments was done to test the adequacy of the questionnaire in eliciting the needed response. The focus was on the structure of the English language, validity and consistency of the questions. It was undertaken with construction professionals who eventually did not form part of the actual data collection exercise. The pilot study was useful to the researcher because it proved to the researcher whether the questions were eliciting the needed responses required for the study. It also indicated to the researcher whether there would be the need for follow-up questions to ensure clarity. This made the researcher to anticipate and prepared for the possible questions which made the survey very successful.

3.8 Validity and Reliability of Data

The findings of a study will take credence from its validity and reliability. (Saunders et al.2007).The observed that these two constitute the credibility of a study. Validity confirms if the findings actually represent what they purport (Atkinson & Flint, 2001). They further referred to validity as the ability to generate findings beyond a specific study". For qualitative data analysis, they refers to validity as how the researchers" data

analysis accurately represents the realities in the field. They gave four points on the authentication and trustworthiness of a research project:

- Ecological Validity: How the researchers data represent the response of respondents and the extent to which the researcher serve to distract respondents.
- Natural Validity: In-depth account of a logical procedure
- Member Validation: Confirmation of researcher‟s report by the elements he studied.
- Competent Insider Performer: Researchers participation as an element of studied population

The validity of this study is rooted in the close alignment of the research questions, frame of reference and the design and purpose of the questions administered in the questionnaires distributed to respondents. The data gathered directly, addressed the issues raised in the research question. With a well calculated approach to sampling, the administration of questionnaires to respondents, cross checking of data and alignment of the research questions to respondents‟ answers, the findings of the study reflected generally the perceptions of safety planning tools and techniques among Ghanaian contractors.

The operations of the study such as data collection procedure can be repeated with the same results (Atkinson & Flint, 2001). In this regard, I first established rapport with the people by visiting them on few occasions and familiarizing myself by interacting with them, reading brochures on their products and services and browsing their websites. The respondents of the questionnaires were also treated with tact and the questionnaires were administered meticulously so as not to influence any response.

Simple language was used in the questionnaire to facilitate understanding in addition to thorough explanation of the purpose of the questionnaire. The steps to be employed to gather data was coherent and reinforced each other:

3.9 DATA ANALYSIS AND STATISTICAL CONSIDERATIONS

According to Sullivan (2001), data analysis can be the most challenging and interesting aspect of research. It refers to deriving meaning from the data that had been collected in a study. Data analysis assumes many forms. Quantitative data analysis involves the use of statistical methods to assemble, classify, analyze and summarize the data to derive meaning. As indicated earlier, field research was conducted to collect data from civil engineers, project managers, managing directors and safety officers of the construction firms involved in the study using questionnaires.

After the data collection, data reduction was conducted to select, arrange, refine, focus and summarize the data for onward analysis. The data collected was transformed into a form appropriate for manipulation and analysis. The data gathered from the questionnaire was edited to ensure completeness, consistency and accuracy. Statistical Package for Social Sciences version 17 and Microsoft excel were used in processing primary data obtained through questionnaires survey. In analyzing the data, tables and figures were used to present the results from descriptive statistics and relative index.

Quantitative explanations was made on quantitative data to give meaning to them and to also explain their implications. From these, appropriate conclusions and recommendations were made from the findings of the research.

3.10 CHAPTER SUMMARY

This chapter addresses the research procedure or methodology of this study, explain the sample selection, describe the procedure or methodology employed in designing the tool and gathering the data, and provide an explanation of the statistical procedures employed to analyze the data.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 INTRODUCTION

The study adopted a mixed method approach in data collection. Data collection was done through both secondary and primary sources. The secondary source (literature review) which is the first stage of the data collection process was extracted from documented facts using plain sheets and other relevant materials. After conducting a comprehensive literature review and positioned the study within its theoretical context; survey questionnaire which is the second stage of the data gathering process was adopted for the study to collect the primary data. Data generated was subjected to descriptive statistics in terms of percentages, frequencies, mean scores and relative index and ranking of various variables using computer programmed referred to as Statistical Package for Social Sciences (SPSS) version 17 and Microsoft excel. This chapter presents the data analysis and discussions of the findings of the study.

In all, 40 questionnaires were self-administered to D1K1, D2K2 contractors working on projects in Upper East Region of Ghana. All the 40 questionnaires were completed and retrieved. After retrieving the completed questionnaires and subjected to data screening,

the 40 questionnaires representing 100% response rate were considered valid and formed the basis of the analysis presented in this chapter. However, there were missing values in some completed questionnaires. The analysis is pivoted around the objectives of the study, which are, to assess the level of knowledge of contractors on safety planning tools and techniques, to assess the level of usage of safety planning tools and techniques by contractors and to identify practical measures to improve safety planning by contractors. The research utilized tables and figures in presenting the study findings.

4.2 DEMOGRAPHIC PROFILE OF RESPONDENTS

This set of data was intended to describe demographic variables of the sample and to assess the level of impact it has on the findings of the study. Demographics refers to qualities such as age, sex, income levels etc. relating to a set or particular group of people. For this study, the demographic data consisted of class of company, job positon in the company, level of education, years of experience and years of existence of firm. Tables 4.1 to 4.4 and figures 4.1 and 4.2 below summarizes the demographic profile of respondents by class of company, job positon in the company, level of education, years of experience and years of existence of firm.

4.2.1 Contractor's financial class

Figure 4.1 shows the class of company of the respondents‟ companies. Respondents were asked to indicate the class of company of their respective companies whether it is a D2K2 or D1K1 contracting firm. According to Figure 4.1 the survey shows that 76 % of the questionnaires were filled by D2K2 contractors and only 24% by D1K1 contractors. The above information indicates majority of the contractors who

participated in the study are D2K2 contractors. This could also be an indication that the Ghanaian Construction Industry is dominated by D2K2 contractors.

Literature indicate that contractors that are in a class of D1KI and D2 k2 financial staff are well organized and had safety department to ensure safety monitoring and control (Kheni,2008).

The value of the projects, which are tendered for by D2K2 contractors were general smaller as compared to those that are tendered for by D1 K1 contractor.

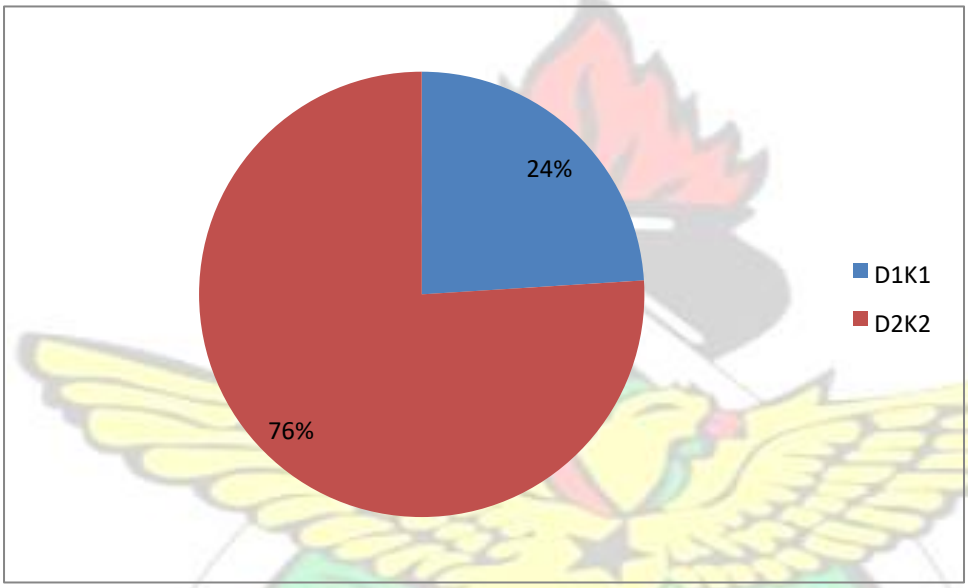

Figure 4.1: Contractor's financial class

Source: Field survey, 2014

4.2.2 Job positions of respondents in the company

Out of the 40 respondents participating in the study, 14 (35.0 %) of them were project managers in their respective firms. This constitutes the bulk of the respondents. 11 (27.5 %) were civil engineers, 10 (25.0%) were safety officers and 3 (7.5%). However, 2 (5.0 %) of the respondents failed to indicate their position in the firm (see table 4.1).

There is a clear indication that the questionnaires were completed by respondents

occupying remarkable positions in the firms and therefore are likely to provide quality information about safety planning in the firm. This shows that the greater percentage of data collected for analysis will yield better results that can be relied upon. The main participants in charge of construction health and safety are the client, main contractor, statutory institutions and agencies and employees. It is leaders with ability and control who are able to influence the desired behaviors necessary for a safe environment by reinforcement of the organization‟s safety standards (Wentz, 1998).

Table 4.1: Job positions of respondents in the company

Job position	*Frequency*	*Percent (%)*	*Valid Percent (%)*	*Cumulative Percent (%)*
Project Manager	*14*	*35.0*	*36.8*	*36.8*
Civil Engineer	*11*	*27.5*	*28.9*	*65.8*
Safety officer	*10*	*25.0*	*26.3*	*92.1*
Managing Director	*3*	*7.5*	*7.9*	*100.0*
Total	*38*	*95.0*	*100.0*	
Missing system	*2*	*5.0*		
Total	*40*	*100.0*		

Source: Field survey, 2014

4.2.3 Educational level of respondents

This question was asked in order to identify the educational level of the respondents. The data obtained revealed that out of the 40 respondents, 20 (50%) are First degree holders, 11 (27.5%) also attested to the fact that they have Diploma, while 3 (7.5%) each of the respondents also said they had certificates which may be Construction Technician Certificate (CTC) or postgraduate Certificate, This means that majority of the respondents are educated and therefore they can read and write, which means that

they would be able to understand the questions on the questionnaire survey and provide reliable information. this will allow the researcher an opportunity to access level of study of constriction related safety issue as well as professional qualification which may reveal planning tool and techniques. These personnel who can read and write would able to interpret simple safety signage on site to laborers on construction site and could be well informed of the legal obligation of ensuring that their project site are kept safe. Since the workforce relied much on their managing director and supervisors for information or communication on safety issues bordering them.

Table 4.2: Educational level of respondents

Educational level	*Frequency*	*Percent (%)*	*Valid Percent (%)*	*Cumulative Percent (%)*
First Degree	*20*	*50.0*	*54.1*	*54.1*
Diploma	*11*	*27.5*	*29.7*	*83.8*
Postgraduate	*3*	*7.5*	*8.1*	*91.9*
Certificate	*3*	*7.5*	*8.1*	*100.0*
Total	*37*	*92.5*	*100.0*	
Missing system	*3*	*7.5*		
Total	*40*	*100.0*		

Source: Field survey, 2014

4.2.4 Years of experience of respondents in the Construction Industry

This question was asked in order to identify and categorize the respondents according to their work experience in the construction industry which was measured in terms of the number of years practiced. The data obtained revealed that out of the 40 respondents, 17(42.5%) have between 6 to 10 years work experience, 12(30%) also attested to the fact that they have more than 10 years‟ work experience, while only 9

(22.5 %) confirmed that they have less than one to 5years work experience in the construction industry.

The experience of the respondents in the context of this research is determined by the number of years of practice and active involvement in the construction industry. The idea here is that a person‟s years of experience is likely to have a direct influence on his knowledge on how the construction industry plans safety and therefore based on table 4.3,

Those who responded to the survey questionnaires are sufficiently experienced in safety planning to provide credible data as illustrated in the table 4.3 below.

Table 4.3: Years of experience of respondents in the Construction Industry

Years of experience	*Frequency*	*Percent (%)*	*Valid Percent (%)*	*Cumulative Percent (%)*
More than 10 years	*12*	*30.0*	*31.6*	*76.3*
6-10 years	*17*	*42.5*	*44.7*	*44.7*
Less than one year-5years	*9*	*22.5*	*21.1*	*97.4*
Total	*38*	*95.0*	*100.0*	
Missing system	*2*	*5.0*		
Total	*40*	*100.0*		

Source: Field survey, 2014

4.2.5 Years of Existence of Respondents Company

The result presented in Table 4.4 below, illustrates that 21(52.5%) of the contractors have been in existence for more than 10 years, 15 (37.5%) of them have been in existence for between 6 – 10 years. Only 2(5.0%) of the contractors have been in existence for less than one year to 5years in the construction field. The findings point

out that 90% of the respondents obtained more than five (5) years working experience. The long working experience of the contractors would give the results more consistency and consequently, their responses to the problems would also reflect the fundamental situations in the construction industry.

Table 4.4: Years of Existence of Respondents Company

Years of Existence	*Frequency*	*Percent (%)*	*Valid Percent (%)*	*Cumulative Percent (%)*
More than 10 years	*21*	*52.5*	*55.3*	*55.3*
6-10 years	*15*	*37.5*	*39.5*	*94.7*
Less than one year-5years	*2*	*5.0*	*2.6*	*97.4*
Total	*38*	*95.0*	*100.0*	
Missing system	*2*	*5.0*		
Total	*40*	*100.0*		

Source: Field survey, 2014

4.2.6 Existence Safety department in the company

The responsibility of safety management despite being the responsibility of each employee in the firm, if assigned to designated department will help achieve safety success for the firm. The survey conducted sought to establish whether there exist a separate safety department in respondents firms. Respondents were asked a „yes" or „no" question concerning this situation. The results after analyzing the data is presented in figure 4.2 below. From figure 4.4, it was established that out of the 40 respondents, 78% responded „yes" and 22% responded „no" indicating that majority of Ghanaian construction firms are shown by the study to have safety departments. Some client may

be influence by the years of existence in the industry in relation to safety management issue before engaging a contractor to carry out a construction project.

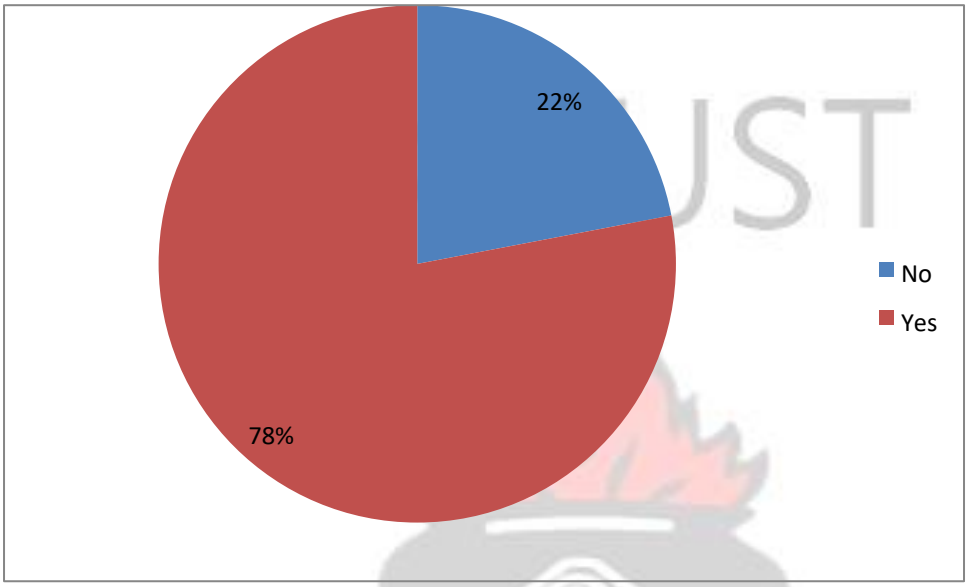

Figure 4.2: Existence of safety department?

Source: Field survey, 2014

4.3 LEVEL OF KNOWLEDGE ON SAFETY PLANNING TOOLS AND TECHNIQUES

The survey conducted in his section of the study sought to give respondent the opportunity to indicate their level of knowledge on safety planning tools and techniques. To achieve this objective, the survey questionnaire captured nine famous safety planning tools and techniques as listed in table 4.3 below. Respondents were therefore asked to express their level of knowledge on each of the safety planning tools and techniques using a rating scale of 1 to 4, where 1=None, 2=Limited, 3=Working knowledge and 4=Very good working knowledge. Data generated was subjected to relative index and the results showing ranking of the factors based on the level of knowledge expressed by the respondents on each factor is presented in table

4.5 below.

Table 4.5: Level of knowledge of safety planning tools and techniques

No.	Safety planning tools and techniques	Rating				Total number of respondents (f)	$\sum W$	$\sum$ Mean= W/ f	RI	Rank
		4	3	2	1					
1	Cost benefits analysis: Cost-Benefit Analysis involves adding up the benefits of a course of laction, and then comparing these with the costs	20	8	7	1	36	119	3.31	0.74	1st
2	Benchmarking: Improves performance by identifying and applying best demonstrated practices to operations.	13	18	5	0	36	117	3.25	0.73	2nd
3	Trails and stimulations: This is to ensure that controls developed are adequate to address situations that might occur on the stimulated project.	11	14	10	0	35	106	3.03	0.66	3rd
4	Flowcharting is a tool for analyzing processes. It allows you to break any process down into individual events or activities.	6	18	12	0	36	103	2.86	0.64	4th
5	Process mapping is a tool to visually illustrate how the work flows. It is also a communication tool and a tool to help manage the organization.	7	14	14	1	36	100	2.78	0.63	5th
6	Risk management process tools and techniques: This involves analyzing the project to find out some risks in order to manage them for optimum safety.	7	15	12	2	36	98	2.72	0.61	6th
7	Project Safety Requirement Review: It is assessing the various operations of the project as well as the results of the project and how to safely carry out the operations and achieving the results	6	15	14	1	36	97	2.69	0.61	7th
8	Cost of safety: Involves determining the cost of implementing safety measures purposely to determine whether to implement or not to implement a safety plan.	4	20	9	2	35	94	2.69	0.59	8th
9	Additional safety planning tools: These include any other tools apart from those already listed above which your company or institution uses.	2	6	20	8	36	68	1.88	0.43	9th

Source: Field survey, 2014

From Tables 4.5 above, it is clearly seen that from the respondents‟ point of view, the 9 most important safety planning tools and techniques (in order of importance) in terms of knowledge level are as follows:

- Cost benefits analysis;
- Benchmarking;
- Trails and stimulations;
- Flowcharting;
- Process mapping;
- Risk management process tools and techniques;
- Project Safety Requirement Review;
- Cost of safety; and
- Additional safety planning tools.

The study sought to find out from respondents their level of knowledge on the safety planning tools and techniques listed above. Table 4.5 shows the various safety planning tools and techniques. From the analysis of the results, it can be seen that the item where majority of respondents ranked first is cost benefits analysis. Indicating that respondents had much knowledge on cost benefit analysis, benchmarking and trails and simulation as a safety planning tool whiles it was revealed that respondents have among the nine factors, the least knowledge on additional safety planning tools since it was ranked at the bottom.

4.3.1 Cost benefits analysis

A cost benefit analysis, simply put, is the monetary or safety valuation of the risk of performing a task as against benefit of performing the task (performing the task in a certain manner). The findings of the study is in line with Gines"s (2010) assertion that Cost-Benefits Analysis is best for making quick and simple financial decisions. The results in table 4.5 shows that respondents have the highest knowledge on cost benefits analysis among all the nine identified safety planning tools and techniques included in the study. 35 (97%) of the respondents who responded to this question stated clearly that they have some form of knowledge on cost benefits analysis. From the total of 35, 20 indicated that they have a very good working knowledge, 8 indicated that they have a working knowledge and 7 indicated that they have limited knowledge on cost benefits analysis. However 1 representing 3% of the respondents reported that he has no knowledge at all on cost benefit analysis. These results ranked cost benefit analysis first with an RI value of 0.74.

4.3.2 Benchmarking

Benchmarking is referred to the process of enhancing performance by constantly identifying, understanding, and adapting best practices and processes establish inside and outside an organization. Benchmarking should be seen as a tool for improvement within a wider scope of customer focused improving activities and should be driven by customer and internal organization needs. The study found benchmarking as one of the popular safety planning tool among Ghanaian contractors. Benchmarking was ranked second in terms of the knowledge level of respondents on benchmarking after cost benefits analysis with an RI value of 0.73 (see table 4.5). 13 (36%) of the respondents

indicated that they have a very good working knowledge, 18 (50%) have working knowledge and 5 (14%) have limited knowledge on benchmarking. None of the respondents indicated that they have no knowledge on benchmarking. This means that Ghanaian contractors have significant knowledge level on benchmarking as a safety planning tool.

4.3.3 Trails and stimulations

With regard to the level of knowledge respondents on safety planning tools and techniques, trails and stimulation was ranked third with a corresponding RII score of 0.66 (table 4.5). Trails and stimulations are carried out to ensure that controls developed are adequate to address situations that might occur on the stimulated project. 11 out of 35 respondents who responded to the question indicated that they have a very good working knowledge, 14 reported that they have a working knowledge and 10 reported that they have limited knowledge on trails and stimulation as a safety tool. Again, none of the respondents reported not to have any knowledge of trails and stimulation.

4.3.4 Flowcharting

Flowcharting is an instrument used for examining processes. It breaks any process down into separate events or activities and to display these in shorthand form showing the logical relationships between them. Constructing flowcharts allow for an enhanced understanding of the processes, and enhanced understanding of the processes is a pre-requisite for improvement. Flowcharting is used to improve understanding of how a process is carried out, to study a process for improvement, to communicate to others how a process was carried out, when enhanced communication is required between

people involved with the same process to document a process and when planning a project (Michel, 1994). From table 4.5 above, Flowcharting was ranked fourth with an RI score of 0.64. Indeed, all the respondents (100%) indicated that they have knowledge on flowcharting as a safety tool/technique. Majority of the responses are however those who confirmed they have a working knowledge, followed by those who have a very good working knowledge and by those with limited knowledge on flowcharting.

It is therefore essential that contractors have knowledge of these tool and techniques. It is also important that safety planning should be critically taken into account by contractors or parties on a project. Regular safety meetings, training, education and thorough inspections are very crucial. This helps the parties concerned in a project to be aware of the progress of safe working conditions that are on site. (Sengupta, 1999) stated that prevention of accidents on construction site is a matter of education, training co-operation, vigilance and effective safety planning. The development of safety plan is key to a construction site of any kind to identify dangers early so as to provide the right control measure (Cheung et al., 2004). Construction industries have very large scope which is therefore unlikely to possess all the necessary knowledge to identify all dangers in the scope of work (Carter & Smith, 2006).

4.4 Level of usage of Safety Planning Tools and Techniques

This section seeks to understand the level of the safety planning tools and techniques in respondents operations. The results of the analysis using relative importance index is illustrated in table 4.6 below. Here, a rating scale of 1 to 4, where 1=Not at all, 2=Seldom, 3=Frequent and 4=All the time was adopted.

Table 4.6: Level of usage of safety planning tools and techniques

No.	Safety planning tools and techniques	Rating				Total number of respondents (f)	ΣW	Mean =	$\Sigma W/(f)$	RI= $\Sigma W/(5*N)$	Rank
		4	3	2	1						
1	Cost benefits analysis: Cost-Benefit Analysis involves adding up the benefits of a course of action, and then comparing these with the costs associated with it.	21	8	10	0	39	128	3.3		0.8	1st
2	Benchmarking: Improves performance by identifying and applying best demonstrated practices to operations.	15	16	5	2	38	118	3.1		0.74	2nd
3	Process mapping is a tool to visually illustrate how the work flows. It is also a communication tool and a tool to help manage the organization.	7	23	8	1	39	115	2.9		0.72	3rd
4	Cost of safety: Involves determining the cost of implementing safety measures purposely to determine whether to implement or not to implement a safety plan.	10	15	11	2	38	110	2.9		0.69	4th
5	Trails and stimulations: This is to ensure that controls developed are adequate to address situations that might occur on the stimulated project.	9	16	11	3	39	108	2.8		0.68	5th
6	Project Safety Requirement Review: It is assessing the various operations of the project as well as the results of the project and how to safely carry out the operations and achieving the results	4	19	16	0	39	106	2.7		0.66	6th
7	Flowcharting is a tool for analyzing processes. It allows you to break any process down into individual events or activities.	3	20	15	1	39	103	2.6		0.64	7th
8	Risk management process tools and techniques: This involves analyzing the project to find out some risks in order to manage them for optimum safety.	2	21	15	1	39	101	2.6		0.63	8th

9	*Additional safety planning tools: These include any other tools apart from those already listed above which your company or institution uses.*	*4*	*6*	*16*	*13*	*39*	*67*	*1.7*		*0.42*	*9th*

Source: Field survey, 2014

Like the level of knowledge, respondents were given the opportunity to indicate the level of usage of the safe planning tools and techniques in their operations. As indicated in table 4.6 above the following are nine (9) safety planning tools and techniques in order of most frequently used among Ghanaian contractors as far as the findings of the study is concerned:

- Cost benefits analysis;
- Benchmarking;
- Process mapping;
- Cost of safety;
- Trails and stimulations;
- Project Safety Requirement Review;
- Flowcharting;
- Risk management process tools and techniques; and
- Additional safety planning tools.

The findings of the study is solely based on the opinions of the respondents. There was some form of consistency in data provided by the respondents. This is said as a results of both the knowledge and usage levels data ranked cost benefits analysis and benchmarking first in both cases and also additional safety planning tools been ranked at the bottom in both cases. It is normally believed that the level of knowledge affects the level of usage of an article hence this consistency. On the contrary, there was a disparity where flowcharting obtained a high rank in terms of knowledge level but was ranked low in terms of usage level and cost of safety obtained a high rank in terms of usage level but a low rank in terms of knowledge level. The question here is that why

are respondents reporting that they most frequently use safety planning tools and techniques they have least knowledge on and vice versa. The reason may be that there were differences in how respondents interpreted the data.

However, among the nine (9) safety planning tools and techniques, the following are the five (5) most frequently used among Ghanaian contractors: cost benefits analysis (ranked 1st), benchmarking (ranked 2nd), process mapping (ranked 3rd), cost of safety (ranked 4th) and trails and stimulations (ranked 5th) whiles risk management process tools and techniques (ranked 8th) and additional safety planning tools (ranked 9th) were revealed by the study as the rarely used safety planning tools and techniques among Ghanaian contractors, Construction project site safety issues are influenced by owners who are very committed to high standards above the stipulation of the safety and Health Laws in the country, there are owners that would examine a contractor based on the way they carry out their safety planning procedures and practice which would convince them that the required safety plan is in place before the start of work on a construction project site. All those who are engaged in construction are concerned that their work should be very safe and that condition on the project site will not cause injury or damage to their health and professional skills, by adapting the right tools and techniques so as to save cost. Safe practice in construction project result in safe construction site (Lingard et al., 2005).

4.5 DESCRIPTIVE STATISTICS OF PRACTICAL MEASURES TO IMPROVE SAFETY PLANNING

Safety control is a person's perception of the ability or opportunity to manage work situations to avoid injuries and accidents. This section of the questionnaire sought to

give respondents the opportunity to show by indicating on a four point Likert scale, where 1=strongly agree, 2=agree, 3=disagree and 5=strongly disagree, their extent of agreement or disagreement to practical measures to improve safety planning among Ghanaian contractors identified in table 4.7 below. This was a bid to suggest effective and practical measures to improve safety planning from the respondents‟ point of view. In analysing the data collected, descriptive statistics was used and ranks for the various variables were provided. The results of the analysis showing mean scores, standard deviations and the associated standard mean errors (SEs) is presented in table 4.7 below.

In establishing the relative significance of the measures on the four-point Likert scale rating, a success measure was deemed significant if it obtained a mean value of equal to or less than 2.0 since the scale adopted highest ratings as 1 and 2 for strongly agree and agree respectively. A significance level was set at 95% in accordance with orthodox risk levels. The element of standard deviation measures consistency in responses by obtaining the difference between the highest value of the standard deviation and the lowest value of standard deviation. If the difference between them is low, i.e. being close to zero (0), the consistency is high as far as the responses are concerned and vice versa.The fact that all the standard error means were close to zero (0) indicates that the sample mean is more likely to reflect the actual population mean. More so, the fact that all the variables had standard deviations less than 1.0 (see table 4.7) indicates that there was very little variability in data generated and hence no or very little differences in how respondents interpreted the variables. Alternatively, standard deviation values of less than 1.0 indicate consistency in agreement among the respondents of the reported level of results. Where two or more variables obtain the same mean, the variable with the least standard deviation is assigned the highest rank.

Table 4.7: Descriptive statistics of practical measures to improve safety planning

PRACTICAL MEASURES	*N*	*Mean*	*Std. Error Mean*	*St. Dev.*	*Rank*
Organizing joint venture safety planning programmed.	*37*	*1.7838*	*.13498*	*.82108*	*1st*
Staged a review for design safety plan before issued for construction.	*38*	*1.7632*	*.12753*	*.78617*	*2nd*
Prepare site specific safety plan checklist.	*37*	*1.7027*	*.09384*	*.57081*	*3rd*
Employee safety training programmed.	*37*	*1.6486*	*.08850*	*.53832*	*4th*
Site safety training to assist you in understanding and completing a site safety plan.	*38*	*1.6316*	*.08781*	*.54132*	*5th*
Prepare emergency plan and procedures for hazardous work.	*36*	*1.6111*	*.09153*	*.54917*	*6th*
Establishing clear roles and safety standards.	*36*	*1.5833*	*.09237*	*.55420*	*7th*
Consider Contract and Project stakeholder's requirements when performing safety planning.	*36*	*1.5833*	*.09237*	*.55420*	*7th*
Examining the contractor's current and past safety plans performance history.	*38*	*1.5789*	*.08117*	*.50036*	*8th*
All information on hazardous substances is registered and assessed in a central catalog.	*38*	*1.5789*	*.08950*	*.55173*	*9th*
Employee involvement in safety planning.	*36*	*1.5278*	*.09332*	*.55990*	*10th*

Source: Field survey, 2014

According to table 4.7 above, all the measures obtained mean scores less than the hypothesized mean of 2.0 (meaning significant). Hence respondents‟ agreement to the identified measures as the significant practical measures to improve safety planning among Ghanaian contractors. Although all the identified measures have been proved significant by the study, it is further revealed that the level of significance of the measures varies with an evidence of all the mean scores not being equal.

However, among all the significant measures, *employee involvement in safety planning* has been revealed by the study as the most significant measure. This is an indication that the involvement of employees in safety planning in the firm is a key success factor to safety planning. This measure obtained a mean score of 1.5278 which is deemed the most significant based on the rating scale adopted with a corresponding standard deviation of .55990 and was ranked first by the respondents (table 4.7). Another significant measures for improving safety planning revealed by the findings of the study is *registering and assessing all information on hazardous substances in a central catalog* and *examining the contractor's current and past safety plans performance history* in the firm. These factors both obtained a mean score of 1.5789 and standard deviations of .55173 and .50036 and ranked second and third respectively.

Moreover, *considering contract and project stakeholder's requirements when performing safety planning* and *establishing clear roles and safety standards* were also shown by the study as significant measures to improve safety planning by contractors with both recording a mean score of 1.5833, a standard deviation of .55420 and ranked fourth. This is a vindication that with clear established roles and safety standards, safety planning is improved. With the suggested measures illustrated in table 4.7 above, contractors will be able to improve upon their safety planning.

No contractor want accidents to occur and to prevent these accidents construction site does not have to be turned upside down, it does not require lot of money or the commitment of large resources. The construction project site only need to apply the prescribed preventive principle and demonstrate these principle at all time by management to personnel for employees safety, it is therefore not out of place that the finding of the study is in line with what had been found in literature as best practice in

the improvement of safety planning on construction project site. Therefore project managers cannot afford to wait till material or human resource is damaged before the necessary steps are employed, so safety planning means applying safe practical measure before accidents happen, efficient and effective safety plan outlined three main objectives, which are ensuring a safe work environment, safe job and providing protection to the workforce or the human resources, which the study also agree that employee involvement in safety planning is key since they are directly involved in construction site activities (Rowlinson, 2004).

4.6 CHAPTER SUMMARY

Data analysis and discussions of the results have been presented in this chapter systematically and chronologically according to the items in the questionnaires. The purpose of the study was laid out together with the research objectives. Data was analyzed using computer programmes called SPSS and Microsoft excel. Descriptive statistics in terms of percentages, frequencies, standard deviations, mean scores and relative importance index were used and pie diagrams, bar graphs and tabulations were added to summarize the results. The results were supported by references to the literature where applicable. The next chapter is devoted to presenting a summary of the findings, conclusions and recommendations drawn based on the findings of the study.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATION

5.1 INTRODUCTION

The construction industry is the second most risky industry in terms of health and safety after the mining industry. It is therefore important that safety planning issues in the

construction industry should be reviewed so as to recommend practical measures to improve safety planning.

5.2 SUMMARY OF FINDINGS AND CONCLUSION

After undertaking the survey in this research, the aim of the research (to improve on safety planning by contractors) was achieved. Most of the results obtained from the study agreed with most of the findings from previous research on how to improve safety planning practice by contractors. However, others were on the contrary whiles new facts were also revealed.

Below is a summary discussion of the findings under each of the objectives.

Objective 1

To access the level of knowledge of contractors on safety planning tools and techniques.

Most of the contractors who were first degree holders said they have been in the construction industry for more than 10 years. With this years of existence, 78% of them said there exist safety department in their company. It is therefore no wonder when the majority of them, when asked on their level of knowledge of safety planning tools and techniques gave answers that demonstrated that they had working knowledge in cost benefit analysis, benchmarking , trails and simulation, flow charting and process mapping. However on the average none of the respondents indicated they had very good working knowledge in any of the techniques. Apart from the eight tools and techniques for safety planning that were listed in the questionnaire, it can be concluded that contractors have little or limited knowledge in other safety planning tools and techniques as demonstrated by a response indicating limited knowledge in additional

tools and techniques safety planning tools. It is therefore necessary for contractors to be innovative in bringing on board new safety planning tools or learning or exploring about other workable safety planning tools.

Objective 2

On the issue of level of usage of safety planning tools and techniques, responses from contractors indicated that tools and techniques such as cost benefit analysis, benchmarking, process mapping, cost of safety, trails and stimulation, project safety requirement review and flow charting where frequently used on site. However apart from the safety planning tools and techniques used above, contractors do not use or have many safety tools and techniques that are used on site. This is evident in their responses which depict that additional safety planning tools are seldom used. If then contractors demonstrated very good working knowledge as well as high level of usage of the safety planning tools and techniques yet there is a high accident rate in the construction industry then more innovative tools and techniques for safety planning will have to be adopted.

Objective 3

On the issue of practical measures to improve safety planning, most Ghanaian contractors agreed strongly that improvement can be achieved by working on these areas:

- Employee involvement in safety planning.
- All information on hazardous substance should be registered and assessed in a central catalog.
- Contractors current and past safety plans performance history should be examined.

- Contract and project stakeholder‟s requirement during safety planning should be considered.
- Clear roles and safety standards should be established.

5.3 Recommendation

Based on the findings, the following recommendations can be made to contractors.

- In order to achieve adequate safety planning on construction project, contractor should improve upon project safety requirements review and their risk management process. To achieve this contractors should review project to identify risky areas and plan towards reducing or eliminating these risk. Also contractors should review projects to identify the residual risk so as to consider them in future projects.
- Project safety requirement review and risk management process tools techniques which were not mostly used on site could be as a result of poor or no supervision from health and safety institutions in Ghana. Therefore regular and strict supervisions should be carried out by the authorities in the required institutions of health and safety.

The mining industry comes first as the most risky industry in Ghana. Second to the mining industry is the construction industry where site accidents are very rampant. If , from the survey, contractors demonstrated very good working knowledge and frequent use of the safety planning tools and techniques like cost benefit analysis, benchmarking, process mapping and trails and simulation yet accident cases are very numerous on site then there is still a problem. It is therefore recommended that future researchers should

consider venturing into areas that will bring out innovative tools and techniques to aid safety planning for construction projects.

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APPENDICES

Dear Sir / Madam,

Please be informed that I am a final year research student from Department of Building Technology, Kwame Nkrumah University of Science and Technology,

Kumasi. I am 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 on the publication. Below are the contact details of the research student.

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EXPLORING THE LEVEL OF KNOWLEDGE AND USAGE OF SAFETY PLANNING TOOLS AND TECHNIQUES BY D1K1 AND D2K2 BUILDING CONTRACTORS IN GHANA (CASE STUDY UPPER EAST REGION).

The aim is to improve on safety planning by contractors in Ghana.

The questionnaire is in four sections:
Section A: Particulars of Respondent.

Section B: To assess the level of knowledge of contractors on safety planning tools and techniques.

Section C: To assess the level of usage of safety planning tools and techniques by contractors.

Section D: To identify practical measures to improve safety planning by contractors.

SECTION A: (socio-demographic characteristics of the respondents)

Please answer or tick ☑ where appropriate

- Class of company D1 K2 ☐ D2 K2 ☐
- What is your job position in the company?

☐ Managing Director

☐ Project Manager

☐ Safety Officer

☐ Civil Engineer

Others (specify)

- What is your level of education?

☐ Postgraduate

☐ First Degree

☐ Diploma

☐ Certificate

Others (specify)

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

☐ Less than one year – 5 years

☐ 6 - 10 years

☐ More than 10 years

- How long has your company been in existence?

☐ Less than one year – 5 years

☐ 6 - 10 years

☐ More than 10 years

- Does your company have a Safety department?

☐ Yes

☐ No

SECTION B

Knowledge level of safety planning tools and techniques

Please express your level of Knowledge on safety planning tool and techniques on a scale of 1 - 4.

1. None 2. Limited 3. Working knowledge 4. Very good working knowledge

Tools	1	2	3	4

16	Cost benefits analysis. Cost-Benefit Analysis involves adding up the benefits of a course of action, and then comparing these with the costs associated with it.	☐	☐	☐	☐
17	Benchmarking. Improves performance by identifying and applying best demonstrated practices to operations.	☐	☐	☐	☐
18	Trails and stimulations: This is to ensure that controls developed are adequate to address situations that might occur on the simulated project.	☐	☐	☐	☐
19	Cost of safety: Involves determining the cost of implementing safety measures purposely to determine whether to implement or not to implement a safety plan.	☐	☐	☐	☐
20	Process mapping is a tool to visually illustrate how the work flows. It is also a communication tool and a tool to help manage the organization.	☐	☐	☐	☐
21	Flowcharting is a tool for analyzing processes. It allows you to break any process down into individual events or activities.	☐	☐	☐	☐
22	Project safety requirement review: It is assessing the various operations of the project as well as the results of the project and how to safely carry out the operations and achieving the results.	☐	☐	☐	☐
23	Risk management processes tools and techniques: This involves analyzing the project to find out some risks in order to manage them for optimum safety.	☐	☐	☐	☐
24	Additional safety planning tools: These include any other tools apart from those already listed above which your company or institution uses.	☐	☐	☐	☐

SECTION C

Level of usage of safety planning tools and techniques.

Please indicate your level of usage of the safety planning tools and techniques in your operations on a scale of 1- 4

1. Not at all 2. Seldom 3. Frequent 4. All the time

	Tools	1	2	3	4
16	Cost benefits analysis. Cost-Benefit Analysis involves adding up the benefits of a course of action, and then comparing these with the costs associated with it.	☐	☐	☐	☐
17	Benchmarking. Improves performance by identifying and applying best demonstrated practices to operations.	☐	☐	☐	☐
18	Trails and stimulations: This is to ensure that controls developed are adequate to address situations that might occur on the simulated project.	☐	☐	☐	☐
19	Cost of safety: Involves determining the cost of implementing safety measures purposely to determine whether to implement or not to implement a safety plan.	☐	☐	☐	☐
20	Process mapping is a tool to visually illustrate how the work flows. It is also a communication tool and a tool to help manage the organization.	☐	☐	☐	☐
21	Flowcharting is a tool for analyzing processes. It allows you to break any process down into individual events or activities.	☐	☐	☐	☐
22	Project safety requirement review: It is assessing the various operations of the project as well as the results of the project and how to safely carry out the operations and achieving the results.	☐	☐	☐	☐

23	Risk management processes tools and techniques: This involves analyzing the project to find out some risks in order to manage them for optimum safety.	☐	☐	☐	☐
24	Additional safety planning tools: These include any other tools apart from those already listed above which your company or institution uses.	☐	☐	☐	☐

SECTION D

What practical measures would you suggest to improving safety planning?
Please indicate on a scale of 1-4. 1- Strongly agree, 2- Agree, 3- Disagree, 4 – Strongly disagree

	Practical measures	1	2	3	4
25	Examining the contractor‟s current and past safety plans performance history.	☐	☐	☐	☐
26	Employee safety training programmed.	☐	☐	☐	☐
27	Organizing joint venture safety planning programmed.	☐	☐	☐	☐
28	Employee involvement in safety planning.	☐	☐	☐	☐
29	Establishing clear roles and safety standards.	☐	☐	☐	☐
30	Consider Contract and Project stakeholder‟s requirements when preforming safety planning.	☐	☐	☐	☐
31	Prepare emergency plan and procedures for hazardous work.	☐	☐	☐	☐
32	Preparing site specific safety plan checklist.	☐	☐	☐	☐
33	All information on hazardous substances is registered and assessed in a central catalog.	☐	☐	☐	☐

34	Site safe training to assist you in understanding and Completing a site specific safety plan.	☐	☐	☐	☐
35	Staged a review for design safety plan before issued for construction.	☐	☐	☐	☐