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The Effect of Site Layout Planning on Labour Productivity on Construction Sites in Ghana
(A Case Study of Construction Sites in Accra)

by

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MASTER OF SCIENCE

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DECLARATION

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

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ABSTRACT

Over some years, many projects in Ghana have experienced delay and abandonment due to improper initial work management plan, which includes site layout planning. This situation has led to cost and time overruns in distinct projects in the country. Hence, the main purpose of the project is to assess the effect of site layout planning on labour productivity on construction sites in Ghana. To achieve the purpose, an empirical study is conducted, gathering quantitative relevant information, to address the key questions featured in the study, namely, what are the merits of employing site layout plan on construction sites in Ghana? What are the factors that are considered in achieving an effective site layout planning on construction sites in Ghana? And what are the effects of site layout planning on labour productivity on construction sites in Ghana? Survey questionnaires were administered to 60 management staff and 90 labourers involved in an on-going construction project. A total of 12 merits, 12 consideration factors and 4 effects are identified based on their sources and their content in detail. These compilations with their respective significance levels will help practitioners, central state agencies, and researchers in managing problems involved in the planning of site layout especially on labour productivity on construction sites in developing countries. The study recommends that a best practice framework for facilitating the effective adoption of proper site layout planning on construction sites in Ghana be developed.

Keywords Site layout planning, Labour productivity, Temporary facilities

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All errors and omissions are entirely mine.

DEDICATION

This dissertation is dedicated to my family.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

All over the world the construction industry plays a pivotal role in the oiling of all major economies. Ballard and Howell (1998) considered the construction of buildings as a production in a temporary factory. He referred to the site, as the „factory" in which the production of buildings takes place. It is therefore very essential, that the process for the realization of any construction project is well thought out and coordinated to arrive at the final goal, just as any production line in a factory. This is where site layout planning becomes very important.

The planning of construction sites have over the years evolved from experience to the involvement of modern scientific techniques and models of site analysis leading to an optimum plan, (These include fuzzy, heuristic, algorithms, AutoCAD analysis and many more) which have helped site managers to plan their site for an effective and efficient realization of any construction project.

The fundamental to any successful project carried out is the way and manner in which the construction site layout is efficiently planned. This challenging task, as part of the construction process, usually involves identifying supporting temporary facilities that will aid in the construction process, determining their shape and size, and locating them in areas that will not affect operations within the boundaries of the construction site. Among these temporary facilities are site offices, car parking lots, warehouses, batch plants, areas for maintenance, and area for fabrication.

Khalafallah and El-Rayes (2005) ascertain that the construction site layout plays a major role in attaining the „deliverables" in the construction industry. The „deliverables" here in refer to safety, quality, cost control and time.

As construction progresses, however, the site layout may need to be adjusted dynamically at various stages of the construction to accommodate operational needs especially where there is limited space.

Furthermore, an efficient site layout plan minimizes the time used in traveling and cost of moving plant, labour, and materials on site. Activity interference with construction operations are also minimized, thereby preventing or reducing site accidents. In effect productivity and progress on any construction site is either enhanced or adversely affected by the outcome of the site layout plan (Foster 1986; Tommelein *et al.,* 1992b;

Cheng and O‟Connor 1993).

According to Borcherding and Liou, (1986) "productivity" is an expression that shows the relationship between outputs and inputs. Labour productivity is normally referred to as manpower in terms of labour cost to the quantity of outputs produced (Borcherding and Liou, 1986). labour productivity can also be defined as the amount of goods and services produced by a productive factor (manpower) in the unit of time (Drewin, 1982). Again, labour productivity measures a system‟s total effectiveness that employs labour, equipment and capital to turn efforts of labour into outcomes that are useful. It does not indicate to the strength of labour alone.

The two most important measures of labour productivity are:

- the effectiveness with which labour is used in the construction process;
- the relative efficiency of labour doing what it is required to do at a given time and place (Dozzi and AbouRizk, 1993).

The construction industry contributes immensely to the economies of the world. As stated by Ogunsemi *et al* (2008), "the construction industry is a viable sector in the economy of any country." It is considered as one of the major determinants of the country‟s Gross Domestic Product (GDP), as it contributes an average of 8.5% of

Ghana‟s GDP (Ghana Statistical Service, 2007).

Again, the construction industry employs about 2.3 % of the economically active population in Ghana 2002 (Amankwa, 2003). It is in view of the important role construction plays in Ghana‟s national development that Owusu-Sekere (2008), and Nduro (2010), indicated that "the activities of the industry have great significance to the achievement of national socio-economic goals of providing infrastructure and employment." According to Roy (2005), "it is evidenced that noticeable development and the aesthetic transformation of the environment is bound up with and predicated on the construction industry."

1.2 PROBLEM STATEMENT

Anumba and Bishop (1997) argue that a poorly planned layout and an untidy site is the reason for most accidents on construction site in Ghana, resulting from falling materials and collisions. Limited spaces, especially in urban construction sites, have been a challenge to an effective layout plan, and a layout which does not properly address the health and safety needs of the workforce compromises on productivity. For safe and efficient running of all construction operations, it is very important that as part of preparation and budgeting proper planning is done by Management.

Site layout planning has been cited by Calis and Yuksel (2010) as a major aspect in the construction process that has been treated lightly.

The attitudes of the project Managers and site Engineers have been that it will be done as and when it is needed. It is imperative to note that the conditions posed by the site layout plan will be the one within which all the stakeholders involved in the project will have to stay with for the whole project duration. It is in this wise, that a cautious pre-planning of the site is needed. Labour cost constitutes about two-thirds of the entire cost of a project,

for substantial saving to be made then the safety, health and welfare concerns of the workforce are to be considered in the planning of the layout (Elbeltagi and Hegazy, 2002).

Many projects in Ghana experiences delay and even abandonment due to improper initial work management plan, which includes site layout planning. There are cases in Ghana where problems arising from cost and time issues have led to suspension of major construction projects. Therefore many variations and stoppage orders are issued in the course of the construction (Rao and Culas, 2014).

A visit to most construction sites reveal that most of the temporary on-site facilities, as may have been originally planned, have not been provided. In some situations the plans are not implemented to the fullest. In most cases the site looks untidy and disorganized, leading to site accidents and posing safety issues.

Can we say, then, that site layout plan as implemented on construction sites, leads to the needed and required productivity as envisaged during the site layout planning process and also during the construction period?

This brings to the fore the relevance of construction site layout planning as an important process of construction management that cannot be underestimated.

It is against this background that this research seeks to assess the effect of site layout planning on labour productivity on construction sites in Ghana.

1.3 RESEARCH QUESTION

The following research questions were proposed:

- What are the merits of employing site layout plan in construction?

- What factors are considered in achieving an effective site layout plan? and
- What effects does the site layout planning have on labour productivity on the construction site?

1.4 AIM OF THE STUDY

The aim of the research is to assess the effect of site layout planning on labour productivity on construction sites in Ghana.

1.5 OBJECTIVES OF THE STUDY

The research also seeks to undertake these specific objectives:

a) Identify the merits of employing site layout plan in construction;
b) Examine the factors that are considered in achieving an effective site layout plan; and
c) Identify the effects of site layout planning on labour productivity on construction sites.

1.6 BENEFIT TO INDUSTRY

- To contribute to knowledge in the development and efficient usage of site layout plan in the Ghanaian construction industry
- To help improve labour productivity by imploring good and efficient layout plan on construction sites.

1.7 SIGNIFICANCE OF THE STUDY

The outcome of this study will be of significant benefit to the key stakeholders in the Ghanaian construction industry such as Contractors site engineers, Consultants and the ordinary worker on any construction project in the country. The study will provide relevant

information on the effects of site layout plan as employed as part of the construction processes in any major project and its influence on labour productivity on the construction site. It brings to the fore the merits of utilizing site layout plan and also brings to bear the factors that one has to examine in order to have an effective and efficient site layout plan. This study will significantly change the attitude of construction site managers in regards to site layout planning, on how it is conceived and implemented.

1.8 METHODOLOGY

The study was mainly descriptive; it dwelled in part on published and unpublished sources and other information collected by the researcher. A substantial amount of secondary data was obtained from published sources including statistical sources and the Internet. Primary data was obtained through fieldwork, as well as interviews, questionnaire survey, and personal observations of some major construction sites in Accra. These techniques were used to gather factual information as well as opinions from stake holders in the construction industry on the theme of the study. Field work, including photography enabled the investigator to observe and record relevant information for subsequent analysis. Data obtained from all sources were analyzed and interpreted with software‟s such as IBM Statistical Package for Social Sciences (SPSS 23.0) in such a manner that they yielded answers to the research questions and provided information for comparative study.

1.9 LIMITATIONS

The main scope of this study was on live, on–going, non-residential construction projects within the Accra Metropolitan area in the Greater Accra region of Ghana. The study generally focused on the implementation of site layout plans and its effect on labour

productivity on construction sites. It didn‟t consider the size of the plot on which the projects were situated.

The issue of limited literature written specifically on effects of site layout planning on labour productivity on construction sites in Ghana posed difficulties when the researcher was reviewing related literature. Time and financial constraints cannot be understated since a thesis of this nature and magnitude requires ample time and funds. Access to information is fraught with bureaucracies, delays and restrictions. The data for this study were retrieved from secondary sources and questionnaire responses (primary) and therefore the authenticity of the data was dependent on the accuracy of the data accessed.

1.10 ORGANIZATION OF THE STUDY

The research has been organized into five (5) chapters. These are:

Chapter One-Introduction

This chapter involves a brief background on site layout planning and management, in the Ghanaian construction industry, the aim, objectives, research questions, scope of the study, and methodology as well as the statement of problem for which reason the study was carried out.

Chapter Two-Literature Review

This chapter reviews extensive related empirical literature on the subject matter.

- Site layout planning
- Merits of site layout planning
- Productivity in the construction industry
- Factors considered in planning an effect construction site
- Effect of site layout planning on construction labour productivity

Chapter Three-Research Methodology;

This chapter consists of the various means used to attain and analyze research data. It also indicates the theoretical framework for the study.

Chapter Four-data analysis and discussions

Analysis and discussion of collected data will be done in this chapter.

Chapter five-Conclusion and Recommendation

This chapter involves the interpretation of analyzed data, recommendations and conclusion of the project as well as the appendices.

1.11 SAMPLE FRAME

The sample framed will be the composition of various participants in the construction industry. Namely;

- Project consultants
- Site Engineers of construction companies
- Workforce (skill and unskilled)

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

This chapter reviews extensive related empirical literature on the subject matter. Although information is this area of study is limited, efforts would be made to obtain the relevant literature in the following areas; merits of site layout planning, site layout planning techniques, factors considered in planning an effective and efficient construction site, productivity in the construction industry, factors affecting productivity in the construction industry, and effects of site layout planning on construction workforce productivity.

2.2 SITE LAYOUT PLANNING ISSUES

Site layout planning is the organisation of a construction site in preparation for the construction of a major project. It involves the identification and location of temporary facilities on site. It is in this sense that Ballard and Howell (1998) considered the construction of buildings as a production in a temporary factory. He referred to the building site, as the „factory" in which the production of buildings occurs, hence the need for it to be organized just as any production line in a factory.

2.2.1 Site Layout Planning Significance

A site layout plan plays a significant role in the construction process in that it shows the relationship between the proposed site and the surrounding environment within which the project will be located. It indicates how to approach the site and how communication on site is done. It also shows the actual position of the project on site and the ancillary supporting facilities which includes site offices, warehousing, stores and workshops (Elbeltagi and Hegazy, 2002).

Construction of any project involves the movement of labour, plants and materials with its implied cost. Hence a good site layout plan will go a long way to minimize the travel time

and movement cost of these factors of production in construction (Foster 1986; Tommelein *et al.,* 1992b; Cheng and O'Connor 1993).

It also ensures that site accidents are reduced if not eliminated. Again it prevents the disrupted of work by other construction activities. Productivity and progress of any project can either be enhanced or adversely affected by the way the site layout is done (Foster 1986; Tommelein *et al.,* 1992b; Cheng and O'Connor 1993).

2.2.2 Merits of Site Layout Planning

Seetharaman *et al.,* (2011) outlines some of the merits of implementing or employing site layout plan as part of the construction process;

1. smooth and economic running of the project
2. reduces the project duration
3. material wastage and deterioration are reduced
4. material transportation become easy, speedy and economical
5. increases the output from labour and machinery
6. Provides more safety in the working of the project.

2.2.3 Problems Associated with an Unplanned Site Layout.

Elbeltagi and Hegazy (2002) acknowledges that failing to plan the site layout right at the inception of the project, may lead to some inefficiency in the construction operations, and can substantially affect the overall cost of a project. They outlined some of the problems that may arise if there is no site layout plan, as follows;

a. Wrong location of material stacks.

The delivery of materials on site, are sometimes off-loaded into areas where it has not been thought of as the correct point of delivery. This may result in a situation where the material

will have to be handled severally before they are finally used. The material may be too remote from the work area or too far from the plant or equipment. Due to wrong location of materials traffic flow on site may be affected.

b. Plant and equipment wrongly located.

Plants and equipment needed for the project have to be identified and arrangement made for their arrival on site. On arrival at site, their location has to be determined, but because there is no plan made in connection with that some problems arise. These include;

- The inaccessibility of the crane to deliver materials;
- Inadequate storage space for aggregates;
- all parts of the works cannot be reached by the fixed crane;
- Capacity of hoist insufficient or not high enough to cater for the loads or wrongly sited to serve the building floors;

c. Limited space to stack materials.

In situations where the space allocated for material stacking is limited, materials are stacked too high or on access ways rendering it hazardous to workers. Spaces for operation may become too congested implying more space should be assigned with the consequent wasting of time as a result of moving materials to new locations.

d. Ineffective usage of site huts due to their location.

Due to the lack of an efficient plan, site huts may be located in areas with conditions that are not conducive for work, or far away with little overview of the site which may render their use ineffective. Space allocated for warehousing may be inadequate and also located at an obscured place.

To avoid the above problems it is essential to plan a detail site layout, indicating where all equipment, materials storage areas, accommodation and ancillary areas for work will be located.

2.2.4 Present Practice in Site Layout Planning

In any construction project there are a number of preplanning tasks that needs to done before the commencement of actual work. These tasks include scheduling, selection of construction method, procurement and material planning, manpower and equipment planning, and financial planning. The planning of the site layout is of equal importance just as any of the other tasks in construction planning. It is the site layout that will provide the space within which the other tasks can be accomplished. On the contrary Project Managers turn to overlook this important aspect of the construction process or treat it lightly (Elbelgati *et al.*, 2004).

Project Managers and site Engineers usually design the layout and allocate the various temporary facilities required on site. Their design is based on past experience, common sense, and the use of similar site layouts in allocating spaces for temporary facilities on site. In most cases they fail in keep in mind of all the factors that affected their selection, location, and the functional relationship that existed between all the facilities they have allocated (Elbelgati *et al.*, 2004).

2.2.5 Site Planning Elements

Elbelgati *et al.*, (2004) established that generally there are two objectives which site managers seek to accomplish, in the organization of a construction site.

First, is to design a layout that will provide the maximum efficiency in construction operations in order to enhance productivity of the workers, to reduce project duration and to bring down cost. Secondly, it is the aim of every planner to create an enabling working environment that will attract and retain the best personnel thereby contributing to better work quality and productivity.

2.2.5.1 Factors to Consider in Planning a Site Layout

For an effective and efficient site layout to be achieved there are certain factors that have to be considered in the planning and implementation of a site layout plan. These factors when properly addressed, will aid in the smooth running of any construction process. From the review of literature, the factors below came to light;

1. Health and Safety

The health and safety concerns of all personnel and even the surrounding environment within which construction operations are performed should be of paramount interest to the site layout Planner on any construction site. To avoid claims as a result of accidents on the site, the site layout should be planned in a way that will prevent or minimize accidents on the site. Fire extinguishers are to be placed at vantage points identified on the site layout to help fight any fire outbreak (Khalafallah and El-Rayes, 2005; Elbelgati *et al.,* 2004). Medical services should be considered during the planning stage of the layout to provide first aid in case of injuries and in remote areas a well-equipped medical facility with medical personnel is recommended. Basic safety supplies like safety boots, helmets, goggles and gloves must be provided for the workers to use. The workers must be trained on health and safety issues pertaining to the site they are working on (Khalafallah and El-Rayes, 2005; Elbelgati *et al.,* 2004).

2. Site Accessibility

Good planning is needed to link the site roads to a major highway nearby. Roads within the site are needed to allow work to flow easily. Spaces for parking of vehicles are to be provided. Where space does not exist this facility must be planned and provided somewhere convenient. Easy movement will keep the morale of the equipment and vehicle drivers high, thus minimizing the chance of accidents. It will also save time in maneuvering in and out of the construction site ((Elbelgati *et al.,* 2004; Seethraaman,

2011).

3. Information Signs

Signage as a form of communication should be of an outmost consideration during the planning of the site layout. It should be visible and in clear plain language that is easy to comprehend, indicating what to do and what not to do on site, to avoid unnecessary hit and falls resulting in accidents and injuries. There should be a site map which will show details of the project; this should be exhibited boldly in the site Engineers or project Managers" office and also posted at the entry point. Strategically traffic regulatory signs should be located to direct traffic on the site to prevent accidents as much as possible (Elbelgati *et al.,* 2004; Seethraaman, 2011).

On every floor an emergency escape routes should be displayed as construction progresses. Protect all services underground to save it from destructions. It is also important to mark out all hazardous areas with caution tape.

4. Security

The security of the site should be of prime consideration to the site planner if the project should end successfully. The whole site should be fenced and the entrance strategically located with a guard post to check the ins and outs movement of all personnel and vehicles in order to check pilfering. The whole site should be illuminated at night to prevent intruders to the site (Khalafallah and El-Rayes, 2005; Elbelgati *et al.,* 2004).

5. Accommodation and Craft change-houses

Some form of accommodation should be provided for all categories of personnel involved in the project on site, especially when the project is large. On small or restricted site, accommodation for only the site engineer and the security man should be considered and arrangement should be made for others nearby.

Craft change-houses should be provided for workers to change, keep clothes, bath and relax during breaks. This space should have toilet facilities for their convenience (Elbelgati *et al.*, 2004).

6. Site Offices

For an efficient and effective monitoring of the project site offices should be provided with meeting or conference room. All the offices should be close together and in a safe area. They are to be properly equipped to meet the needs of the project (Elbelgati *et al.*, 2004).

7. Utilities (electricity, water, telecommunication, internet,)

All the necessary utilities available should be harnessed to the advantage of the project. In areas where water is a problem arrangement can be made for tanker services or a borehole can be sunk to provide water. In areas with no power supply a generator plant can be installed to provide electricity. All of these should be strategically located so as not to impede operations of the construction (Elbelgati *et al.*, 2004).

8. Handling of Materials

Elbelgati *et al.*, (2004) posited that material handling makes up about one-third of all construction operations. The use of proper equipment for material handling and advance planning will minimize multiple handling which will result in direct cost and time savings.

9. Storage and site cleaning

It is necessary to plan and reserve storage areas for materials so that multiple movements of materials are prevented. Reserved areas for long term or short term storage of large materials and equipment should be clearly defined.

Warehousing should be provided when there is the need to store materials and equipment for a relatively longer period.

It is necessary to have designated area to dispose of waste and debris on site (Khalafallah and El-Rayes, 2005; Elbelgati *et al.,* 2004).

10. Workshops

Workshops should be provided, if possible for all tradesmen working on the project. Workshops are used to fabricated materials and equipment on site. They include plumbing, electrical, carpentry, mechanical, and steel works. If possible there should be a laboratory for testing with all the essential equipment and qualified personnel to be in charge of it (Khalafallah and El-Rayes, 2005; Elbelgati *et al.,* 2004).

11. Nature of project

This will play a great role in the preparation of the site layout. If it is a multistoried building project then it will require a centrally located layout scheme. On the other hand if it is a highway construction project then it will require a number of construction centers at suitable locations (Elbelgati *et al.,* 2004; Seethraaman, 2011).

12. Construction methods

The method of construction will to a large extent influence the planning of the site layout. The construction method can be either cast in-situ or the use of precast elements. If it is to be of precast element then provision for casting yard should be included in the layout planning (Elbelgati *et al.,* 2004).

13. Plot size and shape

The size and shape of the plot should be assessed during the planning of the site layout. The size of the plot will determine what can be accommodated on the site. A site with limited space needs proper planning, facilities that are more necessary should be located on site. Where there is the luxury of space the layout plan can have all the necessary facilities that will aid in the construction process. In situations where space is limited, alternative arrangement should be made to cater for the needed facilities on site

(Elbelgati *et al.*, 2004).

14. Location of project

The location of the project will to some extent determine the outcome of the final site layout plan. How far or closer it is will also tell the kind and size of temporary facilities to be provided. In situations where skilled labourers are not readily available, special arrangement should be made to accommodate those that are being imported for their lodging. Again special on site services must be provided for projects that are far away from industrial centers. These include batch plant, maintenance workshops, warehousing, and even recreational centers must be provided. Alternative arrangement should be made for areas where there is no electricity, water or telecommunication service (Elbelgati *et al.*, 2004).

2.3 TEMPORARY FACILITIES CHARACTERISTICS

Elbelgati *et al.*, (2004) identified temporary facilities to have some basic characteristics that need to be understood before they are assigned on any site layout plan for any construction project. Six generic temporary facility characteristics where identified.

1. Meeting safety and environmental requirement:

All temporary facilities should meet safety and environmental requirement. The batch plants should be given special attention due to its high pollution potential. Proper arrangement should be made by Planners to prevent the pollution of the air, water and also to keep noise at bearable levels.

2. Different solutions for the same problem:

Arrangements of a temporary facility can be done in many ways. The site layout planner have several options to choose from, in a situation where he is to provide a warehouse, he can build, use existing facilities, rent, or plan a just in time delivery.

3. Short life span on a specific location:

The duration of the project will determine how long the temporary facility stays on the site. Under normal circumstances they are dismantled immediately the project is completed.

4. Reutilization with modified function at another location:

Temporary facilities on site have shorter life span because of this, planners always consider their reuse. With appropriate modifications, most of the temporary facilities can be used for more different purposes, thereby reducing construction cost significantly. To achieve this, the building material should be properly maintained and stored correctly to prevent deterioration of the material.

5. Easy of assembly, dismantling, and exploitation:

Without any damage to the structure components, temporary facilities constructed in prefabricated modules can easily be assembled and dismantled when the project is completed. It also saves time, since its construction does not require any drying periods

6. Standardization of design:

The design of temporary facilities should be standardized for easy construction and utilization. This will reduce time and cost spent on constructing the facilities. It also makes their maintenance, storage and transportation easy. The gains obtained from continues usage, will results in increase productivity and high quality of work.

2.3.1 Identification of temporary facilities and its selection

The type of temporary facilities needed in the execution of any construction project needs to be carefully identified and selected. This is a difficult task that requires you to consider the conditions and local regulations surrounding the project thoroughly. In recent times, project managers and site engineers produce site layout plans based on their past experience and common sense. All that they do is to revise any site layout plan done in a previous project, by so doing; they leave out some relevant facilities that are expected by

authorities such as a post for first aid or an escape route in case of fire. Providing these facilities later can be more expensive and can lead to low productivity on site (Elbelgati *et al.*, 2004).

Elbelgati, (2014) acknowledges that the choice of temporary facilities on any construction site will be influenced by the factors below;

1. Project under construction:

The type of project under construction will determine the type of temporary facility needed on site. In constructing a power plant for instance, would require more storage and fabricating space for processing electrical and mechanical work than other projects.

2. Type of contract:

The contract type or form has an influence in the choice of temporary facilities on site. In a contract such as turn-key, there can be a combination of both the administrative and construction operations by the contractor, which means for efficiency, fewer but larger temporary facilities can be used. In a situation where management of the project is by a number of different contracts, smaller temporary facilities units should be made available for the use of each individual contractor on site.

3. Location of project:

Projects situated in remote areas or at locations where it is difficult to come by skilled labour, it is required that an additional facilities such as lodging should be provided. Project far from industrial centers would require special facilities to store materials and workshops to fabricate materials and equipment.

4. Size of project

Small projects can be handled from a small structure. Project that will take longer period to complete may require temporary facilities that are more permanent in nature. Providing

lodging facilities for workers on site, can be broken down into three categories as shown in Figure 1:

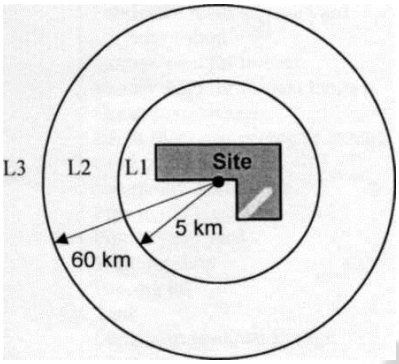

Figure 2.1: Break-down of work force accommodation

LI: local labour force within 5 km from site. Lodging facility not needed nor transportation required.

L2: nearby labour force within 5 to 60 km from site. Facility for lodging not needed, but daily transportation required.

L3: labour force far away from site, more than 60 km from site. Facilities for lodging required (Elbelgati**,** 2014).

In the case of providing for materials storage and warehousing the facilities needed depends on the nature of material and how they are stored to prevent deterioration. However, the nature and number of temporary facilities required in a particular work have to be ascertained before their sizing and location (Elbelgati**,** 2014).

In Appendix III are listed temporary facilities that can be adopted in a construction project. This is to serve as a check list or a guide in the provision of temporary facility on any construction project. Some of the temporary facilities needed are project specific because of their justified uniqueness.

This list of temporary facilities was modified and used as a check list. It was primarily used to check the number of the temporary facilities that have been provided for on each construction sites the researcher visited.

2.4 SITE LAYOUT PLANNING MODELS

Solving problems requires that the problem is presented in a plain language that is easily comprehendible (Li and Love, 1998). As can be seen already the idea of solving the site layout problem has been an area that researchers have interest in. They have explored the use of technology to aid in solving this problem. However, most construction problems are solved by knowledge gained through experience. Li (1994) posited that knowledge gained from experience is not written in books and is weakly organized in memory. Again, conceptualization and definition of the problem becomes more difficult because objectives are not clearly defined and the projects too are unique.

By Roy‟s (1996), definition decision aiding is the activity of the person who, through the use of explicit but not necessarily completely formalized models, helps obtain elements of responses to the questions posed by a stakeholder of a decision process.

One of the typical multi-criteria and multi-objective construction problems that need to be solved is the problem of planning the site layout. It is a routine task for many site managers in both pre-contract and post-contract stages. It is influenced greatly by modes of construction, density of development, and by the nature of the topography (Burges and White 1979). Significantly site layout plan plays an essential role in planning which enhances output (Foster 1986; Chudley 1987; Tommelein *et al.,* 1992a; Wrennall and Quarterman 1994; Cheng and O'Connor 1996).

Gulben *et al* (2010) admitted that construction site layout is one of the challenging duties in construction planning that every site manager will have to solve when undertaken any

construction project. This problem is seen as a formulated combinatorial optimization problem. It is in this wise that Gulben *et al* (2010) proposed the Ant Colony Optimization (ACO) algorithm for solving the problem of site layout. ACO mimics how real ants behave to solve the site layout problem. It came up with solutions that have been proven feasible to solve the combinatorial optimization problems associated with site layout planning. It was observed that the developed ACO model performed a better layout alternative.

Yeh (1995) investigated into the use of neural networks in site layout planning. He constructed a model that reduced the total cost function of a project to a predetermined location and interacting cost between facilities. Genetic algorithm (GA) was used by Li and Love (1998) to solve site-level facilities layout problem which took into consideration the layout hindrances and expectations. Also Mawdesley *et al.,* (2002) suggested a GA means to resolve the site layout problem, by integrating the use of rectangular grid which enabled to specify the area needed easily. Furthermore, Zhang *et al.,* (2002) came out with a master piece which is a hybrid intelligence model in which a superior system is responsible for input and output information of the site layout, and a neural network responsible for the allocation of temporary facilities to free locations. Computer aided design (CAD) was used by other techniques as CAD itself has no capability to solve a problem. Among these studies, Sadeghpour *et al.,* (2004, 2006) and and Pulido-Velazquez *et al* (2005) brought to life the use of CAD with geometric analysis, decision support systems. Zhou *et al.,* 2009 suggested a GA model which incorporates simulation for model space logistics and resources.

Based on the above, this study will look at whether site managers involved in construction projects in Ghana are abreast with this new technology used in solving the site layout problem.

2.5 PRODUCTIVITY ON CONSTRUCTION SITE

Productivity in the construction industry is described in many ways these include; performance factor, production rate, unit person-hour (p-h) rate and others. Traditionally productivity, has been defined as the ratio of input/output, i.e., the ratio of the input of an associated resource (usually, but not necessarily, expressed in p-hs) to real output (in creating economic value). In other words productivity in the construction industry can be defined as; the physical progress achieved per p-h, e.g., p-hs per linear meter of conduit laid or p-hs per cubic meter of concrete poured. The two most important measures of labour productivity are:

- the effectiveness with which labour is used in the construction process;
- the relative efficiency of labour doing what it is required to do at a given time and place (Dozzi and AbouRizk, 1993).

Labour productivity is a measure of the total effectiveness of a system that utilizes labour, equipment and capital to change labour efforts into useful output. It is not a measure of the capabilities of labour alone. Labour productivity usually relates to manpower in terms of labour cost to the quantity of outputs produced (Borcherding and Liou, 1986). In other words, the definition of labour productivity is the amount of goods and services produced by a productive factor (manpower) in the unit of time (Drewin, 1982).

This can be illustrated, by employing a piece of new equipment to do specific operations in on site which results in an increase in output for the same number of labour hours, leading to a higher labour productivity.

2.5.1 Factors Affecting Construction Crew Productivity

For the last 20 years the Ghanaian construction industry has contributed immensely to the gross domestic product of the country. Building construction takes up about 70% of the construction investment made in construction in developing countries (FDI, 2004). It is believed energies directed at enhancing productivity in the construction industry will greatly improve the country's ability to achieve its development goals. In order to achieve this factors that turn to hinder productivity on site needs to be closely examined.

In reviewing the publication put out by the Mechanical Contractors Association of America on impacting factors on construction crew productivity a number of factors came to bare. These factors are grouped or categorized into their source of influence; these are managerial, personal, and nature.

For the purposes of this study the factors that affect construction workforce productivity in relation to site layout planning will be looked at.

1. Scheduling of Trades

When trades are not properly or correctly scheduled especially within a physically limited space with other contractors, it may result in congestion of personnel, not being able to work effectively, additional safety hazards, increase visitors, and prevention of optimum utilization of labour (www.intergraph.com).

2. Joint Occupancy

This occurs when two or more trades have to use or share the same facility or work area or workshop at the same. This may arise when the site layout plan does not consider other work areas for other trades or the work. Joint occupancy can impede smooth flow of work thereby affecting productivity (www.intergraph.com).

3. Beneficial Occupancy

This happens when of working over, around, or nearer to other trades, which may result in ones work been interrupted intermittently or affected by the noise, dust, or any other hazardous element that may pose danger to a worker operating in close proximity. (www.intergraph.com).

4. Site Access interference

This occurs when properly planned access to the work areas are blocked by the thoughtless off-loading of materials at certain locations on site. This may lead to blocked roads, walkways, or congestion work sites resulting in multiple handling thereby affecting work output (www.intergraph.com).

5. Logistics

Insufficient or poor material handling, procurement practices, or a lack of controls can cause procurement or delivery problems, as well as other issues. This then, prevents, delays, or disrupts the normal material workflow to a work area, warehouse, or laydown yard. This can also be a result from the additional replacement or substitution of material due to contract changes, defects, or delays at the work site (www.intergraph.com).

6. Security Check

Security on every site is paramount for the effective running of all construction operations. If the security is compromised it will lead to unnecessary intrusion by strangers, pilfering becomes rampant, the site becomes congested and unnecessary interference of work, resulting in low morale of workers thereby affecting their work output (www.intergraph.com).

7. Confined Space

Productivity is affected when work is done in an enclosed space with limited lighting, and ventilation. This is due to visibility, safety, morale, discomfort, hazards, and other issues

that the work area presents. Time is also lost when getting to and from the work area (www.intergraph.com).

8. Hazardous Work Area

Working in an area classified as hazardous poses a health and safety threat. This requires special safety equipment and clothing before work in these areas can be done. There are restrictions, limit time and exposure of workers to the area, resulting in less time in operation. For example in as much as work can be done in the rain, it comes with inefficiencies due to rain gear, visibility, safety, morale, discomfort, hazards, and other issues (www.intergraph.com).

9. Working in Operating Area

Working in close proximity to operating units such as heat from boilers, smoke from emissions, explosion zones; and so on can result in inefficiencies. This can cause work stoppages, need for protective clothing, work permits, or other requirements thereby affecting productivity (www.intergraph.com).

2.5.2 Site Layout Plan and Productivity

The factors that affect labour output identified above can to a large extent be catered for by having a good site layout plan. A good and an efficient layout plan having all the necessary temporary facilities on site can eliminate or to a large extent reduce the negative influence these factors pose on labour output. The provision of all the welfare facilities such as rest room, toilets, canteen, medical aid, etc. will have the morale of the workers uplifted and thereby increase their output leading to productivity.

Again the workers knowing that there is adequate security, health and safety assurance as provided by the site layout turn to put in more.

Also as per the site layout plan workshops and fabrication areas when clearly defined as much as possible will eliminate factors like, joint occupancy, beneficial occupancy, staggered jobs, proximity of jobs etc.

Further more clearly defined access roads, walkway, proper signage on site to a large extent reduces the incident of human and vehicular conflicts.

Moreover the provision of storage facilities on site helps to keep the integrity of the material intact. Proper storage prevents defects and deterioration of materials. Plants and equipment will be well positioned on site for easy and safe access.

2.5.3 The Effect of Site Layout on Productivity

Khalafallah and El-Rayes (2005) posited that the construction site layout of any construction site, contributes immensely in attaining the „deliverables" in the construction industry. The „deliverables" here in refer to safety, quality, cost control and time.

Again, an effective and efficient site layout plan reduces the time for traveling and moving costs of plant, labour, and materials. Interference with construction operations are also minimized, thereby preventing or reducing site accidents. Again, it also ensures that materials are not stored anywhere and anyhow on the construction site leading to interruptions in construction operations. In effect productivity and progress on any construction site is either enhanced or adversely affected by the outcome of the site layout plan (Foster 1986; Tommelein *et al.,* 1992b; Cheng and O"Connor 1993). Elbelgati (2002) ascertains that most of construction operations involve the handling of materials. Therefore, advance planning and the use of appropriate equipment for material handling, will to a large extent minimize multiple handling that will result in direct cost and time savings, and even improve on the quality of work.

The quality of the work is enhanced by the proper storage and handling of materials, tools, plants and equipment. Good signage and communication on site, clearly defined roads, access and pathways reducing human and vehicular conflict thereby reducing or preventing accidents.

In effect site layout can improve or seriously affect construction productivity and progress. (Foster 1986; Tommelein *et al.,* 1992b; Cheng and O‟Connor, 1993).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

Explanation of the methods employed for the study is provided in this chapter. The main areas covered are research paradigm, design, and population, sampling procedure and sample size, research instruments, data collection procedure and data analysis method.

3.2 THEORETICAL BACKGROUNDS

Guba and Lincoln (2004) group research paradigms into four: that is; positivism; post positivism; critical theory and constructivism. Putting this study in its theoretical scope would require considerations on the variety of available theoretical continuum as a framework to this study. As put by Guba (1990), a paradigm is a fundamental set of views that guides an action. According to Denzin and Lincoln (1998), a paradigm comprises of three prime components, that: epistemology, ontology and methodology. Ontology stance empowers the researcher to choose if the reality is unbiased and peripheral to the researcher, or socially built and only comprehended by investigating the insights of man (Thurairajah *et al.*, 2006). Epistemology is a research theory are which regulates the structure and procedures of social research (Sarantakos, 2005). Epistemology enlightens the methods about the nature of cognizing or about what tallies as a fact and where knowledge is to be pursued (Campana, 2010). For the axiological stance, it is involved with ideals.

This research employed the positivist custom from the epistemology stance. This study was of the opinion that the sophisticated exchanges of know-how practices of construction firms could be researched via systematic but abridged firm method. At the ontological stance, the study employed a realist stance.

3.2.1 Technique of Scientific Examination and Reason

According to Babbie (2008), deductive and inductive thinking are diverse but similar effective paths to making assumptions in scientific study (Babbie, 2008). These methods including, logic and observation, scientifically helps in any form of investigation. Using the positivism, it is proper to think along the way of reasoning logically within the context of this study in an effort to discover the merits of employing site layout, factors that are considered in achieving an effective site layout plan, and the effects of site layout planning on labour productivity on construction sites which is a social as well as quantitative active in nature. Since, deductive thinking works from an overall to particular views making inferences founded on evidences (Burney, 2008).

3.3 RESEARCH STRATEGY AND APPROACH

The approaches for this study were sectioned into diverse parts. These sections are theoretical and empirical. The theoretical section will center on evaluating literature review of site out planning in general and important review of existing literature to identify items required. The study approach must be built in a hearty way to attain certified data for every section of the project. The choosing of this study design was ushered by theoretical expectations, an assessment of existing research and the study purpose and objectives. Decision making about the research approach, strategy and design is fundamental to both theoretical supporting the research and the donations that the study is probable to offer (Harty and Leiringer, 2005).

There are many types of research approaches and data collection methods employed to achieve the desired objectives of a study of this nature. For instance, questionnaire surveys can collect a large number of responses within a relatively short time, but it is difficult to avoid the confounding variables of the research. The case study method of observation is

very useful for studying subjective processes but this represents only a small number of cases of the research. For this research design, both of these data collection methods will be utilized at different stages of the research program. As earlier discussed that the methodological issues concerning every kind of research is best answered with careful consideration of the theoretical concepts of the research: the aim, objectives, and hypothesis and research questions under consideration (Denzin and Lincoln, 1994).

3.4 SURVEY PROCEDURE

Researchers who use positivist view apply a scope of customary alternatives such as surveys and queries (Cohen *et al.,* 2005). According to Isaac & Michael (1997), survey research is an avenue for answering questions that have been raised, to solve problems that have been posed or observed, assess needs and goals set, to determine whether or not specific objectives have been met, to establish baselines against which future comparisons can be made, to analyse trends across time, and generally to describe what exist, in what amount and in what context. Kraemer (1991) opined that survey research is used to quantitatively describe specific aspects of a given population which consist of relationship between variables. Kraemer (1991) gave other characteristics of research survey by asserting that the data required for the survey research are collected from people by using certain portion of the population from which findings can later be generalized back to the population. The rationale for adopting the survey process for this study is embedded in the philosophy of the researcher that the survey process enables data to be gathered from large number of respondents in order to generalize the results of the study.

3.4.1 Sampling Technique and Sample Size Determination

The population for a research as been defined by Parahoo (1997) as the total number of units from which data can be collected, and this includes individuals, artifacts, events or

organizations. Also, Burns and Grove (2003) defined population as all the elements that meet the criteria for inclusion in a study. Sampling is the process of selecting a group of people, events or behaviour with which to conduct a study (Burns and Grove, 2003).

The population as given by the Association of Building and Civil Engineering is one hundred seventy-three (173) registered construction firms in the Greater Accra region. Through the use of purposive sampling the researcher identified those who were in the D1K1 class and had live (on going) construction projects as at the time the researcher was going to the field to be forty-three (43). As one of the criteria, the projects were nonresidential. The target respondents in this research include all members of the building and civil engineering construction firms in the Greater Accra region. As indicated there are one hundred seventy-three (173) construction firms in the region of study.

(Association of building and civil engineering contractor"s website). Statistical method was used in establishing the sample size for the construction firms to be studied. The sample size was determined using the Finite Population Correction for Proportions formula. If the population is small, then the sample size can be reduced slightly. This is because a given sample size provides proportionately more information for a small population than for a large population (Israel, 1992). Yamane (1967:886) provides a simplified formula to calculate sample sizes. A 95% confidence level and P = .5 and a precision level of .10 are assumed.

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

Where n is the sample size, = ? N

is the population size, and = 43 e

is the level of precision. = 0.10

Using the above formula, the adjusted sample size was 30.06 approximately 30. As a result, the study covered thirty (30) construction sites located at different areas within the Accra metropolis. This made it possible for the researcher to observe, live utilization of a site layout plan.

After determining the number of sites to study it came to the sampling of those who will respond to the questionnaires on the various sites. The researcher adopted a snowballing random sampling procedure to obtain the respondents by picking the first three persons who reported to work on the day of the visit to the site as registered in their attendance book. It was done in a manner that all three did not belong to the same trade.

Two respondents were picked at random from management which included the resident engineer, the project manager and the consultants on the project. In all hundred and fifty (150) respondents were contacted five (5) from each construction site to give out relevant information pertaining to the research objectives and questions.

Type of Respondent	Respondents from 30 construction sites	Total
Management	2 x 30	60
Labourers	3 x 30	90
Total Respondents		**150**

3.5 DATA COLLECTION INSTRUMENTS AND PROCEDURE

The main research instruments used for collecting data were questionnaire, interviews and observation. Yin (2003), posited that questionnaires are the most appropriate method for case study research. For this research, questionnaire was employed because it helped to collect data from large number of respondents. Also, questionnaire was used because it made it easy enough to allow full and honest answers. Furthermore, the survey questionnaire to standardized information collected in respect of the same variables for

everyone within the selected sample (Parfitt 1997) as cited in Zahari, (2007). This makes questionnaire survey an indispensable tool in gathering primary data about people, their behaviour, attitudes, opinions and awareness of specific issues.

Three sets of closed and opened-ended questionnaires were designed: one for the site engineer, one for consultant, and three for the work force. The questionnaires for all categories of respondents consisted of four sections. The first section looked at the respondents‟ background information. The second section sought information on merits of site layout planning on construction sites. The third section of the questionnaire examined the factors considered in planning site layouts. The last section sought to find out whether site layout planning has an effect on work force productivity on construction sites.

Interviews were also conducted with some of the labourers who are illiterates but those who could read and write were given the questionnaires to fill out. With regard to those who could neither read nor write the researcher had the help of interpreters during the interview process to interpret the questionnaire into their local languages. The reasons for using interview, although expensive in terms of time and cost, were to obtain extra relevant information from the participants. Due to its flexibility and adaptability in the face-to-face encounter interviews were used. Follow-up questions were allowed.

Apart from the questionnaires and interviews, field observations of the sites were made. Where it was allowed photographs of the organized site were taken during the observation. The site observation provided useful insights into how the sites have been organized into work areas, temporary facility locations, assess road, signage, positioning of plant and equipment, waste collecting areas etc. Personal observation was also used during fieldwork to gather relevant information, especially in situations where the researcher was prevented

from writing or taking photographs particularly on sensitive issues such as site safety and workforce welfare.

3.6 DATA PRESENTATION AND ANALYSIS

The answered questionnaires were coded and analyzed using simple statistical tools such as the IBM SPSS (International Business Machines Statistical Package for Social Sciences) version 23.00. To illuminate the concerns in this study, the data collected were organized in tables. Information involving the background of respondents was also presented in tables. The outcome of the study was correspondingly assessed with the research objectives.

Successively, the results were analyzed statistically using Mean Score ranking and Relative Importance Index (RII) to determine the significant merits of employing site layout plan, effects of site layout planning, and factors that are considered in achieving an effective site layout planning.

3.7 SUMMARY OF THE CHAPTER

The various methodologies and reasons for their adoption for the research were addressed in this chapter. Approach for the research and the mode of collecting data i.e. the use of survey questionnaires were discussed. Also the chapter looked at the various research processes like; the population, data sources, questionnaire developments, questionnaire formats, content and design of the questionnaires, determining sample size, presentation and analysis of data.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION OF RESULTS

4.1 INTRODUCTION

The analysis of primary data collected from one hundred and fifty (150) respondents within 30 statistically selected (using Finite Population Correction for Proportions formula propounded by Glenn Israel (1992)) construction sites within the Greater Accra region are documented in this chapter. Respondents involving labourers and management were randomly selected from the various sites for the study. The management comprised of site engineers, project managers, consultants, quantity surveyors, and civil engineers, while labourers were of masons, carpenters and steel benders. The study focused attention on assessing the effect of site layout planning on labour productivity on construction sites in Ghana. A thorough analysis was done using descriptive statistics in terms of percentages and frequencies. Again the mean score ranking and RII were employed in the data analysis. The results of the analysis was presented in accordance with the specific objectives of this study namely: to identify the merits of employing site layout planning in construction; to examine the factors that are considered in achieving an effective site layout plan; and to

identify the effects of site layout planning on labour productivity on construction sites. In all 150 questionnaires were administered successfully.

4.2 PROFILE OF SURVEY RESPONDENTS (MANAGEMENT)

Survey respondents‟ information was analyzed by descriptive statistics using the (Statistical Package for Social Sciences) statistics v.23. Table 4.1 shows the demographic profile of respondents. The demographic features of the respondents for this study had five components, namely, gender, age, education level, period of working with firm, and area of expertise. Gender distribution was generally out balanced. Male had a higher figure (82.9%) than female (17.1%). The age group of 35 years old to 44 years old had the highest number of respondents with 51.3%, followed by 25 years old to 34 years old with 34.3%. Age groups 15-24 years old had 4.3% and 55-64 years old had 2.9% each. 45-54 year olds only constituted 7.1%. The educational level of the respondents was also examined. Majority of the respondents did not just end at Basic certificate level but furthered into degree. BSc holders dominated the study with 41.4%, closely followed by HND holders with 35.7%. MSc/MPhil holders accounted for 22.9% of the respondents.

Working period with firm was also analyzed. None of the respondents had above 16 years of experience with their current firm. Nevertheless, most of the respondents (37.1%) had up to five years of working experience with their firm. This was closely followed by those (34.3%) within 6 to 10 years of working experience. Respondents with 11 to 15 years of experience accounted for 19.0% of the respondents.

The area of expertise was also scrutinized. From table 4.1, more than half (55.7%) of the survey respondents were site engineers. Project managers constituted 18.6%, while quantity surveyors represented 14.3% of the survey. Consultants and civil engineers comprised only 7.1% and 4.2% of the survey.

Deducing from the analysis, the study was dominated by male site engineers within 3544 years of age with mostly up to 15 years of working experience within their current firms who have obtained MSc/MPhil qualifications.

Table 4.1: Profile of survey respondents (N=70)

Profile category		Frequency	Percent
Gender			
	Male	60	82.9
	Female	10	17.1
Age			
	15-24	3	4.3
	25-34	24	34.3
	35-44	36	51.4
	45-54	5	7.1
	55-64	2	2.9
	Above 65	0	0.0
Education level			
	BECE	0	0.0
	WASSCE	0	0.0
	HND	25	35.7
	BSc	29	41.4
	MSc/MPhil	16	22.9
	PhD	0	0.0
Period of working with firm			
	0-5	26	36.7
	6-10	24	34.3
	11-15	20	19.0
	16-20	0	0.0
	Above 21	0	0.0
Area of expertise			
	Site engineer	39	55.7

Project manager	13	18.6
Consultant	5	7.1
Quantity surveyor	10	14.3
Civil engineer	3	4.3

Source: Researcher‟s survey (2016)

4.2.1 Merits of Employing Site Layout Planning On Construction Sites in Ghana

Using descriptive statistics, the mean statistics and standard deviations of all merit variables were analyzed. Sections of this survey inquired from respondents if site layout planning is an important aspect of the construction process. Unanimously, all the respondents agreed that site layout is indeed a crucial aspect of the construction process. In recognising the significance of the items on the five-point Likert scale rating, a rule of thumb was seen as significant if it attained a mean value greater than 3.0. The survey respondents were hence asked to indicate their perceptions by ranking their level of agreement on a Likert scale of 1 to 5, where 1=I strongly disagree, 2=I disagree, 3=neutral, 4= I agree, and 5=I strongly agree. All the 12 variables had a mean statistic above the 3.0 gauge showing respondents mostly agreed with merit items of site layout planning. The 12 items are; Increases the output from labour and machinery (4.75), It enhances an efficient and an effective communication on site (4.65), It assists in avoiding activity interference during construction work (4.55), Material handling and use become easy and economical (4.52), Provides security to the workforce and machinery (4.52), It helps in avoiding human and vehicular conflict with a clearly define access and exist route (4.45), Provides more safety in the execution of the project (4.40), Material wastage and deterioration are reduced (4.17), It improves upon the turnaround time of labourers on site when executing any task (4.12), It is essential for the coordination of all tasks on site (4.07), Help to reduce the completion time of the project (4.00), Smooth and economical execution of project (3.97).

According to Stevens (1996), standard deviations below 1.0 shows consistency in agreement among the respondents of the informed level of outcomes. In table 4.2, all standard deviations are less than 1.0. This means that respondents had accordingly given high rankings when defining their level of agreement on the 12 merit variables.

Table 4.2: Merits of a site layout planning (N=60)

Merits of a site layout planning	Mean	SD	RII	Rank
Increases the output from labour and machinery	4.75	.437	0.95	1
It enhances an efficient and an effective communication on site	4.65	.481	0.93	2
It assists in avoiding activity interference during construction work	4.55	.675	0.91	3
Material handling and use become easy and economical	4.52	.504	0.90	4
Provides security to the workforce and machinery	4.52	.504	0.90	5
It helps in avoiding human and vehicular conflict with a clearly define access and exist route	4.45	.502	0.89	6
Provides more safety in the execution of the project	4.40	.494	0.88	7
Material wastage and deterioration are reduced	4.17	.668	0.83	8
It improves upon the turnaround time of labourers on site when executing any task	4.12	.555	0.86	9
It is essential for the coordination of all tasks on site	4.07	.312	0.81	10
Help to reduce the completion time of the project	4.00	.611	0.80	11
Smooth and economical execution of project	3.97	.486	0.79	12

Notes: SD=Standard Deviation, Test value=3.0 Source: Researcher‟s survey (2016)

4.2.2 Factors That Are Considered in Achieving an Effective Site Layout Planning On Construction Sites in Ghana

In this section, it became crucial to determine the factors that are considered in attaining an effective site layout planning on construction sites. Respondents were also asked whether they go through the process of site layout planning before the commencement of construction work. Successfully, all respondents indicated they go through such process. respondents were asked to indicate the factors they regard as prime in attaining an effective and efficient site layout planning on a Likert scale of 1 to 5, where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree.

The outcomes were analyzed and presented in order of significance in table 4.3. In establishing the relevance of the variables on the five-point Likert scale rating, a success criterion was seen as significant if it obtained a mean value of equal to or greater than 3.0. When two or more variables have the same mean, the variable with lowest deviation is said to have the highest significance ranking (Ahadzie, 2007). Similarly, the significance level was set at 90% in accordance with orthodox risk levels (Ahadzie, 2007). The element of standard deviation measures consistency in responses by obtaining the difference between the highest value of the standard 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.

As illustrated in table 4.3, the results of the survey revealed that all the twelve (12) factors are essential in achieving an effective site layout planning. With mean values above 4.0, it can be concluded that the factors are crucial to facilitating site layout on construction sites.

Table 4.3: Descriptive statistics factors that are considered in achieving an effective site layout planning on construction sites (N=60)

Factors	Mean	Std. Deviation	Rank
Allocation and positioning of temporary facilities. (Site offices, accommodation and welfare facilities)	4.8000	.40338	1
Shape and size of the plot	4.5833	.67124	2
Workshop positions	4.5167	.50394	3
Material storage and handling	4.4667	.50310	4
Health and Safety conscience	4.4500	.53441	5
Road or access and exist to the construction site	4.3833	.49030	6
Security (hoarding and fencing, check points, security post.)	4.3667	.66298	7
Access to utilities (electricity, water, telecommunication)	4.3333	.47538	8
Construction methods	4.2833	.90370	9
Surrounding environment (soil, nearness to a water body, vegetation, waste handling and disposal etc.)	4.2667	.48246	10
Location of plant and equipment	4.2500	.62775	11
Nature of project	4.2167	.94046	12

Notes: SD=Standard Deviation, Test value=3.0 Source: Researcher‟s survey (2016)

Further queries probed whether respondents‟ firms are aided by any model in coming out with site layout plan. Almost all respondents (91.7%) indicated that they are not aided by any model while 8.3% indicated they are aided by a model. However, none of those who said they are aided by model was able to indicate the name of the model used. This calls for grieve concerns as education of these models need to be informatively advertised to transfer knowledge and clarify thoughts by most professionals often engaged on the construction site.

4.2.3 Effects of Site Layout Planning On Labour Productivity On Construction Sites

Prior to identifying the significant effects of site layout planning, distinct information was solicited from the survey respondents. First, most respondents (79.7%) indicated that their workforce is mostly comprised of both skilled and unskilled workers. The categories of employees were also investigated. Only 1.7% was accounted for by a workforce of casual workers. Meanwhile more than half (76.7%) comprised of both casual and permanent workers. 21.7% of the survey respondents indicated that their workforce is made up of only permanent workers. Significantly, all (100%) revealed that, they provide job training for their workforce. 20% of the respondents indicated that the training is provided in health and safety while 80% of the respondents indicated that training is done when there is an introduction of a new skill (technology), training in health and safety, as well as when there is an introduction of a new material. Also, the management (83.3%) indicated that, labour productivity on site is rated according to work done per week, followed by 13.3% specified that labour productivity on site is rated according to work done per day. With 3.3% representing labour productivity on site, that rated according to work done per month. All the respondents together pointed out that a good site layout plan has an effect on labour performance.

Table 4.4: Descriptive statistics of effects of site layout planning on labour productivity on construction sites

Items	Mean	Std. Deviation	Rank

Cost overrun will be minimized due to the fact that the turnaround time of workers will be minimized and accidents 4.4500 prevented or reduced	.67460	1
The quality of the work is enhanced by the proper storage 4.2667 and handling of materials, tools, plants and equipment	.44595	2
Health and safety and of the workforce are catered for by clearly defining safe work areas, hazardous work areas, security is assured, Proper signage and communication on 4.2167 site. Clearly defined roads, access and pathways reducing human and vehicular conflict thereby reducing or preventing accidents	.41545	3
Work is done on time as per the coordination of all tasks in relation to position and time. The proper location of stores for materials, tools and correct location of plants and 4.2000 equipment on site improves on the turnaround time of workers and minimizes do	.40338	4

Notes: SD=Standard Deviation, Test value=3.0 Source: Researcher"s survey (2016)

In table 4.4, the result showed that, Cost overrun will be minimized due to the fact that the turnaround time of workers will be minimized and accidents prevented or reduced emerged first as the most significant effect of site layout. With a standard deviation less than 1.0, it can be interpreted that, there is little variability in the data gathered and consistency in agreement among the respondents.

Also survey respondents were asked to suggest what can be done to improve upon construction. 45% is of the view that Education and training on the need for site layout planning. 40% is of the respondents also suggested that local authorities should make sure that site layout is fully implemented on every project. This was followed by 15% of the

respondents who suggested that the project site should be spacious for good planning to take place.

4.3 PROFILE OF SURVEY RESPONDENTS (LABOURERS)

Table 4.5 demonstrates the profile of the respondents of the survey. Almost all the labourers were of the male (86.7%) gender, whereas the remaining 13.3% were of the female gender. Specifically, 57.1% of the respondents in this section were between the 35 to 44 years‟ age group, followed by 24.7% in the 25 to 34 age group. 10.5% of the respondents were within the 45 to 54 years‟ age group. However, only 7.6% of the respondents were between the 15-24 years‟ age group.

Investigating the education level, majority (36.2%) of the labourers have acquired the BECE. This was closely followed by 34.3% of the survey respondents having WASSCE/SSCE. NVTI holders comprised 14.3% of the labourers. While O‟level holders accounted for 9.5% whereas HND holders accounted for 5.7% of the labourers.

Examining their period of working with the firm, more than half (62.9%) of the respondents accounted for the study for those with up to 5 years of working with the firm. 26.7% of the respondents comprised those within 6 to 10 years of working their firms. The remaining 10.4% of respondents accounted for within 11 to 15 years of working period with firm. Lastly, the area of expertise was also scrutinized. There was an almost evenly distribution. This constituted Carpenter (34.3%), Steel bender (33.3%) and Mason (32.4%).

Table 4.5: Profile of survey respondents (N=105)

Profile category		Frequency	Percent
Gender			
	Male	91	86.7

	Female	14	13.3
Age			
	15-24	8	7.6
	25-34	26	24.8
	35-44	60	57.1
	45-54	11	10.5
Education level			
	BECE	38	36.2
	WASSCE/SSCE	36	34.3
	HND	6	5.7
	O"level	10	9.5
	NVTI	15	14.3
Period of working with firm			
	0-5	66	62.9
	6-10	28	26.7
	11-15	11	10.4
Area of expertise			
	Mason	34	32.4
	Carpenter	36	34.3
	Steel bender	35	33.3

Source: Researcher"s survey (2016)

4.3.1 Site Layout Planning Issues

The survey was conducted to establish the grounded no respondents" view, the degree at which they agree with the factors that have been catered for in the planning of the site layout. The respondents were asked to indicate their opinions by ranking the factors on a Likert scale of 1 to 5, where 1=bad, 2=fair, 3=neutral, 4=good, and 5=excellent. Using the 3.0 success criterion, the data retrieved was analyzed. In table 4.6, 6 out of the 10 factors were considered significant factors catered for in the site layout planning. They are Nature

of land (4.89), Allocation and positioning of temporary facilities. (Site accommodation and welfare facilities) (4.72), Adequate safety and security measures put in place (4.66), Type of contract and method of construction (4.61), Workshop positions clearly defined (3.64), and Availability of plant and equipment and are well located (3.44). 1 out of the 6 significant factors had a standard deviation (1.09) above 1.0. This suggests that, there is variability in the responses collected on the variable "Availability of plant and equipment and are well located". Meanwhile, four of the items identified were not considered significant to this study since there were below the 3.0 gauge. Well defined areas for material storage and handling, Availability of road or access and exist to the construction site, Availability of waste handling and disposal areas are well located devoid of any environmental problems, and Access to utilities (electricity, water, telecommunication) were the said factors.

Table 4.6: Descriptive statistics of factors catered for in the site layout planning

(N=90)

Factors considered	Mean	Std. Deviation	Rank
Nature of land	4.8889	.31603	1
Allocation and positioning of temporary facilities. (Site accommodation and welfare facilities)	4.7222	.58112	2
Adequate safety and security measures put in place	4.6556	.65619	3
Type of contract and method of construction	4.6111	.74494	4
Workshop positions clearly defined	3.6444	.99788	5
Availability of plant and equipment and are well located	3.4444	1.09248	6
Well defined areas for material storage and handling	2.9222	1.08335	7

Availability of road or access and exist to the construction site	2.7444	.95472	8
Availability of waste handling and disposal areas are well located devoid of any environmental problems	2.6667	.94809	9
Access to utilities (electricity, water, telecommunication)	2.5444	.95000	10

Notes: SD=Standard Deviation, Test value=3.0 Source: Researcher"s survey (2016)

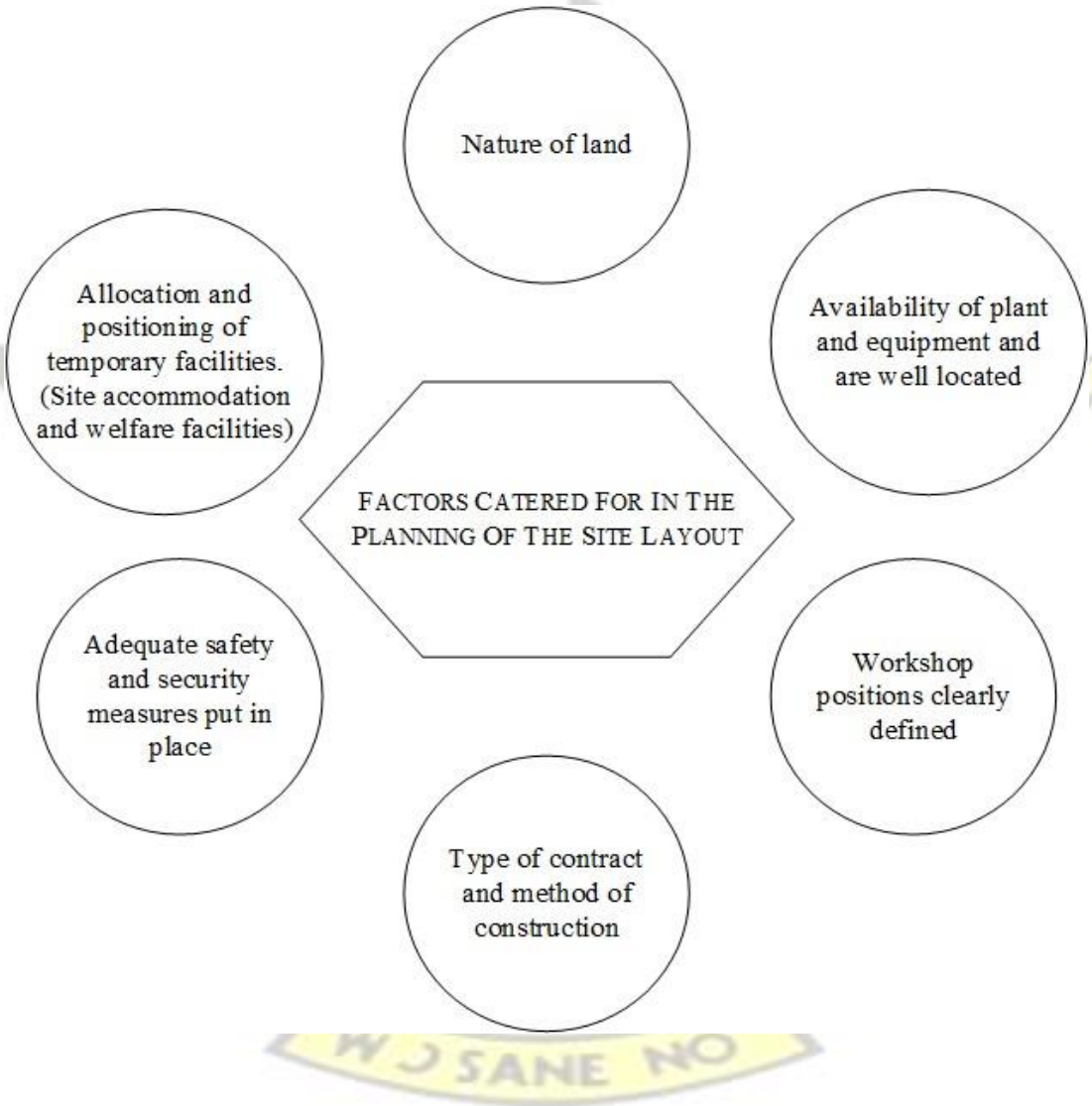

Figure 4.1: 6-point consideration factor wheel for site layout planning

Source: Author's own construct

Furthermore, 87.8% of the respondents indicated that, their impression about the site layout plan they are working with is a good layout. Meanwhile, 12.2% indicated that their impression about the site layout plan they are working with is the best site layout plan. The entire workforce indicated they are skilled. With slightly more than half (53.3%) specifying that they are permanent workers with the remaining 46.7% indicating they are casual workers. In one accord, respondents indicated that they are on the job training is being provided for them. They further explained that, the training is often

(53.3%) done during the training in health and safety, introduction of a new skill (technology), and at the introduction of a new material. 43.3% of the respondents also suggested that on the job training is done during just the training in health and safety period. Only 3% of the respondents indicated that on the job training is done during just the introduction of a new material.

All the labourers within the study indicated that indeed their management provide them with the necessary tools, equipment and attire to ensure safety on site. The time to report to work and close from work was also examined. Majority (90%) of the labourers report to work at 8:00am and close at 5:00pm. 10% of the respondents suggested that they report to work at 7:30am and close at 4:30pm. Also, respondents indicated that, they rated their output on site according to work done per hour (6.7%). 26.7% of the respondents specified that they rate their output per week. Majority indicated that they rate their output per day (66.7%). All labourers also suggested that, on the average it takes 5 minutes to 20 minutes to transport materials from their location to the point of usage. This is very significant because it indicates the nearness of temporary facilities storing various materials on site were closer to the point of usage. In conclusion, 78.9% of the respondents agreed that they

always meet their target. The remaining 21.1% also indicated that they do not always meet their target.

4.3.2 Effects of Site Layout Planning on Labour Productivity on Construction Site In this section all respondents were asked if a good site layout plan has an effect on labour performance. Successfully, all agreed that site layout planning on labour productivity on construction site. Respondents were further asked to indicate their level of agreement on the extent to which they agree that the facilities and their location on site have improved their output on a 5 point Likert scale, thus 1=I strongly disagree, 2=I disagree, 3=neutral, 4=I agree, and 5=I strongly agree. Six (6) independent variables were identified from literature. All the six items were considered significant for the study as they obtained mean values above the 3.0 gauge. By improving security through signage (5.00), effective communication, fencing and hoarding, clearly define access ways Preventing vehicular human conflict, by improving on safety (less or no injuries) (4.92), By improving the quality of work because materials are well stored and therefore have little or no defects (4.06), By reducing the turnaround time in execution of any task (4.03), By reducing double handling of materials (4.00), and Availability of plant and equipment and are well located (3.90).

Table 4.7: Descriptive Statistics

Factors	Mean	Std. Deviation	Rank
By improving security through signage, effective communication, fencing and hoarding, clearly define 5.0000 access ways Preventing vehicular human conflict		.00000	1
By improving on safety (less or no injuries)	4.9222	.26932	2

By improving the quality of work because materials are well stored and therefore have little or no defects	4.0556	.34709	3
By reducing the turnaround time in execution of any task	4.0333	.31623	4
By reducing double handling of materials	4.0000	.00000	5
Availability of plant and equipment and are well located	3.9000	.45097	6

Notes: SD=Standard Deviation, Test value=3.0 Source: Researcher"s survey (2016)

4.3.3 Field study and Site observation

This process of information gathering afforded the researcher the opportunity to have first-hand information and actually see and experience what is on the ground in the planning and implementation of site layout plans for construction works. It was very evident that site layout plans as part of the construction process could not be circumvented.

From the field survey and observation it was clear managers in the construction industry understood and appreciated the relevance of implementing site layout plans. Theoretically they knew what to do in that regard, but fell short of its full practical implementation and utilization on the ground. What came as a bother to the researcher was the type and number of temporary facilities provided on site. A check of these facilities provided on site in comparison with what was adopted from the review of literature showed implementation inadequacies. Appendix III is a table that shows temporary facilities provided on each site. It was evident that construction site managers were interested in the provision of offices and storage spaces than the rest of the other facilities. It was rather revealing to see just a hand full of the construction sites visited had canteens. Those without canteen had their workers go outside the premises for food or snack during break. Others also bring their food or snack from home. Most of the sites had few workshops for forming and fabrication of materials needed in the construction. In some cases two different trades (eg. a carpenter and a steel bender) had to share one workshop. Arguably, this is not absolutely wrong but

can lead to joint occupancy, beneficiary occupancy, delays and other factors that affect work output. Areas designated to collect and handle waste were inadequate in most cases. Also it was observed that, on most of the sites, no proper spaces were made available for first aid or clinic. What were available mostly were first aid kits. Security wise, all the construction site were fenced and hoarded with security posts and guards. Accommodation on site was nonexistence on most of the sites; only few had site accommodations, basically for the security and some worker who came from distant places. Vehicle parking spaces were inadequate on almost all the sites; this was due to space constraint.

After interacting with both workers and management it came to light that those who couldn‟t fully implement their site layout plans had issues with time, cost, and space (land size).

Cost was an issue to them, in the sense that a full implementation will take a chunk out of their initial mobilization. They think the funds can be used for something else rather than investing in something that is temporary. Also most of the contractors‟ aims at maximizing profit so they provide what they think are necessary. Time was also a challenge to them because it takes some time before you can set up fully so only the facilities that seem necessary to them are provided for initially. Those who wish to do more had the problem with space constraint.

What they considered as most important in the provision of temporary facilities on site, are the stores for materials and office for the Site Engineer which in some cases served as a meeting room.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS 5.1 INTRODUCTION

Finally, this chapter lays out the summary of findings, conclusions drawn from the findings, recommendations and other areas for further research in accordance with this study.

5.2 SUMMARY OF FINDINGS

This section summarizes the findings obtained from the research. This is presented based on the research objectives.

5.2.1 Objective 1

The objective was to identify the merits of employing site layout plan on construction sites in Ghana. This objective was addressed with numerous parameters used in the survey questionnaire to establish the merits of employing site layout plan on construction sites in Ghana. A review of extant literature on site layout plan and merits of employing site layout was done from a global perspective. The extent of literature reviewed enabled the researcher to identify twelve (12) merits. These 12 merits were formulated into questions on the survey questionnaire asking respondents to indicate their level of agreement of the merits when it comes to site layout plan on construction sites.

Analyzing respondents‟ response, it was found that all the identified merits are significant on construction sites in Ghana. Thus, increases the output from labour and machinery, it

enhances an efficient and an effective communication on site, it assists in avoiding activity interference during construction work, material handling and use become easy and economical, provides security to the workforce and machinery, it helps in avoiding human and vehicular conflict with a clearly define access and exist route, provides more safety in the execution of the project, material wastage and deterioration are reduced, it improves upon the turnaround time of labourers on site when executing any task, it is essential for the coordination of all tasks on site, help to reduce the completion time of the project, and smooth and economical execution of project.

5.2.2 Objective 2

The objective was to identify the factors that are considered in achieving an effective site layout planning on construction sites in Ghana. The second objective was achieved by asking respondents to indicate the level of agreement of the consideration factors in attaining an effective site layout planning on construction sites in Ghana drawn from literature based on their experience. The study identified twelve (12) consideration factors from literature. Descriptive statistics was used to determine the significant factors that are considered in achieving an effective site layout planning. All the factors were regarded by respondents as significant, they are; allocation and positioning of temporary facilities (site offices, accommodation and welfare facilities), shape and size of the plot, workshop positions, material storage and handling, health and safety concerns, road or access and exist to the construction site, security (hoarding and fencing, check points, security post.), access to utilities (electricity, water, telecommunication), construction methods, surrounding environment (soil, nearness to a water body, vegetation, waste handling and disposal etc.), location of plant and equipment, and nature of project.

5.2.3 Objective 3

The objective was to identify the effects of site layout planning on labour productivity on construction sites in Ghana. The objective was set to identify the effects of site layout planning on labour productivity on construction sites in Ghana. Hence the study identified four (4) effects, of which all were considered critical in influencing site layout planning on labour productivity on construction sites in Ghana. Cost overrun will be minimized due to the fact that the turnaround time of workers will be minimized and accidents prevented or reduced, the quality of the work is enhanced by the proper storage and handling of materials, tools, plants and equipment, health and safety and of the workforce are catered for by clearly defining safe work areas, hazardous work areas, security is assured, proper signage and communication on site. Clearly defined roads, access and pathways reducing human and vehicular conflict thereby reducing or preventing accidents, and work are done on time as per the coordination of all tasks in relation to position and time. The proper location of stores for materials, tools and correct location of plants and equipment on site improves on the turnaround time of workers and minimizes redo.

5.3 CONCLUSIONS

After conducting this study on the effect of site layout planning on labour productivity on construction sites in Ghana, the research made the following conclusions: The study agrees with opinions of other construction researchers in this area of study, like Elbelgeti, (2014) that site layout planning is an essential aspect in the preplanning process that cannot be overlooked in any construction project. Concerning the merits of utilizing a site layout plan on construction sites, this study suggests that site layout planning when done well increases the output of labour and machinery while enhancing an efficient and an effective

communication on site. Among other merits, it also assists in avoiding activity interference during construction.

The study suggests that health and safety, effective utilization of land size, and allocation and positioning of temporary facilities on the site (site offices, accommodation and welfare facilities) are some of the crucial factors considered in order to achieve an effective site layout plan on construction sites in Ghana.

The study concludes on the suggestions that site layout planning has an effect on labour productivity on construction sites in Ghana in that it helps to improve on the turnaround time of workers, reduce multiple handling of materials on site, improves upon health and safety within the working environment and safe guard the integrity of materials and equipment used in the construction.

In a nutshell the desired "deliverables," that is working within time, and budget, not compromising on safety and health and ensuring that the quality of work done is of a high standard in any project can be achieved through the effective and efficient use of a good site layout plan for any construction project in Ghana.

In effect planning a site layout can either improve or greatly affect productivity and progress in any construction project.

5.4 RECOMMENDATIONS

The following recommendations are made based on the findings in this research and are forwarded to stakeholders and practitioners in the construction industry to help improve the effective adaptation of site layout planning on construction sites in Ghana:

- Construction stakeholders must take the initiative to educate professionals in the industry on site layout planning;

- Those monitoring construction project should insist on a site layout plan before the commencement of the project;
- The provision of a site layout plan should be part of the criteria in the selection of a contractor for any project in Ghana;
- Every Managers in a construction firm must make it a point to promote and encourage the utilization of site layout planning in any construction project;
- Records on activities such as material storage and handling on construction sites should be well kept to monitor the progress of work on site.

5.5 FURTHER RESEARCH AVENUES

Further research can be conducted on the best practice framework for facilitating the effective adoption of proper site layout planning on construction sites in Ghana.

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APPENDICES

APPENDIX I

QUESTIONNAIRE FOR MANAGEMENT

A. Bio - data of respondents*Please, tick appropriately*

1. Please indicate which one best describes you? Male ☐ Female

2. What was your age on your last birthday?

a. ☐ 15-24 years b. ☐ 25-34 years c. ☐ 35-44 years

d. ☐ 45-54 years e. ☐ 55-64 years f . ☐ Above 65 years

3. What is your level of qualification?

a. BECE b. WASSCE c. HND d. Bsc e. Msc/Mphil f. Phd

4. How long have you been working with this firm?

a. 0-5years b. 6-10years c.11- 15years d. 16- 20 years e. above 21 years

5. What is your area of expertise?

……

B. Merits of Site layout planning

6. Do you think site layout planning is an important aspect of the construction process?

Yes ☐ No ☐

7. If no, why……

8. The under listed are merits of an effective and efficient site layout? Please use the ranking below to indicate your level/degree of agreement;

1- *I strongly disagree* ***2 -*** *I disagree* ***3 -*** *neutral* ***4 -*** *I agree* ***5 -*** *I strongly agree*

No.	**merits of a site layout plan**	Rankings				
		1	**2**	**3**	**4**	**5**
i.	Smooth and economical execution of project					
ii.	Help to reduce the completion time of the project					
iii.	Provides more safety in the execution of the project					
iv.	Provides security to the workforce and machinery.					
v.	Material handling and use become easy and economical.					
vi.	It assists in avoiding activity interference during construction work.					
vii.	It is essential for the coordination of all tasks on site					
viii.	It improves upon the turnaround time of labourers on site when executing any task					
ix.	Material wastage and deterioration are reduced					
x.	It helps in avoiding human and vehicular conflict with a clearly define access and exist route.					
xi.	It enhances an efficient and an effective communication on site					
xii.	Increases the output from labour and machinery					

C. Factors considered in achieving an effective and efficient site layout plan on a construction site.

9. Did you go through the process of site layout planning prior to the commencement of construction work?

Yes ☐ No ☐

10. If no, why?.....

11. The under listed are factors considered as prime in achieving an effective and efficient site layout?

Please use the ranking below to indicate your level/degree of agreement;

1*- I strongly disagree 2 - I disagree 3 - neutral 4 - I agree 5 - I strongly agree*

No.	**Factors to consider**	Rankings				
		1	**2**	**3**	**4**	**5**
i.	Shape and size of the plot					
ii.	Nature of project					
iii.	Construction methods					
iv.	Surrounding environment (soil, nearness to a water body, vegetation, waste handling and disposal etc.)					
v.	Road or access and exist to the construction site					
vi.	Access to utilities (electricity, water, telecommunication)					
vii.	Health and Safety concerns					
viii.	Location of plant and equipment;					
ix.	Security (hoarding and fencing, check points, security post.)					
x.	Material storage and handling;					
xi.	Workshop positions					
xii.	Allocation and positioning of temporary facilities. (Site offices, accommodation and welfare facilities)					

12. If any other, please state……

13. Are you aided by any model in coming out with your site layout plan

Yes ☐ No ☐

14. If no, why?……..

15. If yes, which model did you use?…….

D. Effects of site layout planning on labour productivity on construction site

16. Are your workforce……?

a. Skilled ☐ b. unskilled ☐ c. both skilled and unskilled ☐

17. Please state the categories of employees for your company

a. permanent ☐ b. ☐ casual c. both casual and permanent ☐

18. Do you provide on the job training for your workforce?

Yes ☐ No ☐

19. If yes, at what point or period is the training done?

a. training in health and safety ☐

b. introduction of a new skill(technology) ☐

c. introduction of a new material ☐

d. both point a , b and c ☐

e. none of the above ☐

20. How do you rate labour productivity on site?

a. according to work done per i. hour ☐ ii. Day ☐ iii. Week ☐ iv. month ☐

b. when a particular section of work is completed within a period ☐

21. Do you think a good site layout plan has an effect on labour performance?

Yes ☐ No

22. If no why?.....

23. The under listed are effects of an effective and efficient site layout on labour productivity. Please use the ranking below to indicate your level/degree of agreement; ***1****- I strongly disagree 2 - I disagree 3 - neutral 4 - I agree 5 - I strongly agree*

No.	**Effects of an effective and efficient site layout plan**	Rankings				
		1	**2**	**3**	**4**	**5**
1.	Work is done on time as per the coordination of all tasks in relation to position and time. The proper location of stores for materials, tools. and correct location of plants and equipment on site improves on the turnaround time of workers and minimizes double handling as much as possible					
2.	Health and safety and of the workforce are catered for by clearly defining safe work areas, hazardous work areas, Security is assured Proper signage and communication on site. Clearly defined roads, access and pathways reducing human and vehicular conflict thereby reducing or preventing accidents.					
3.	The quality of the work is enhanced by the proper storage and handling of materials, tools, plants and equipment.					
4.	Cost overrun will be minimized due to the fact that the turnaround time of workers will be minimized and accidents prevented or reduced					

24. What do you think can be done to improve upon this construction process of site layout planning?.....

……..

APPENDIX II

QUESTIONNAIRE FOR LABOURERS

A. Bio data of respondents *please, tick appropriately*

1. Please indicate which one best describes you? Male ☐ Female

2. What was your age on your last birthday?

a. ☐ 15-24 years b. ☐ 25-34 years c. ☐ 35-44 years

d. ☐ 45-54 years e. ☐ 55-64 years f. ☐ Above 65 years

3. What is your level of qualification?

……..

4. For how long have you been working with this firm?

a. 0-5years b. 6-10years c.11- 15years d. 16- 20 years

5. What is your area of expertise as a trade‟s man?

……..

B. Site layout planning issues

6. To what extent would you agree that the under listed factors have been catered for in the planning of the site layout?

Please use the ranking below to indicate your level/degree of agreement;

1- bad 2 - fair 3 - neutral 4 - good 5 - excellent

No.	**Factors considered**	Rankings				
		1	**2**	**3**	**4**	**5**
i.	Availability of road or access and exist to the construction site					
ii.	Availability of waste handling and disposal areas are well located devoid of any environmental problems.					
iii.	Allocation and positioning of temporary facilities. (Site accommodation and welfare facilities)					
iv.	Access to utilities (electricity, water, telecommunication)					
v.	Adequate safety and security measures put in place					
vi.	Availability of plant and equipment and are well located					
vii.	Well defined areas for material storage and handling;					
viii.	Workshop positions clearly defined					
ix.	Type of contract and method of construction					

x.	Nature of land					

7. What is your impression about the site layout plan you are working in?

a. Best layout ☐ b. Better layout ☐ c. Good layout ☐

d. Bad layout ☐ e. Worst layout ☐

C. Productivity issues

8. Which category of workforce are you?

a. Skilled ☐ b. unskilled ☐

9. What is the status of your employment?

a. permanent ☐ b. casual ☐

10. Are you provided with training on the job? ☐

Yes ☐ No ☐

11. If yes, at what point or period is the training done?

a. training in health and safety ☐

a. introduction of a new skill(technology) ☐

b. introduction of a new material ☐

c. both point a , b and c ☐

d. none of the above ☐

12. Does management provide you with the necessary tools, equipment and attire to ensure your safety on site?

Yes ☐ No ☐

If no, should it be a shared responsibility ☐ or the sole responsibility of the worker

13. At what time do you report to work…….

14. At what time do you close……..

15. How do you rate your work output on site?

a. according to work done per i. hour ☐ ii. Day ☐ iii. Week ☐ iv. month

b. when a particular section of work is completed within a period ☐

16. On the average how long does it takes to transport materials from their location to the point of usage?

a. 5min – 20min b. 21 – 40mins c. 41mins – 60mind d. 1 hour and above

17. Do you always meet your target?

Yes ☐ No ☐

If no, why…….

D. Effects of site layout planning on labour productivity on construction site

18. Do you think a good site layout plan has an effect on labour performance?

Yes ☐ No

19. If no why? .....

20. To what extent would you agree that the facilities and their location on site have improved your work output?

Please use the ranking below to indicate your level/degree of agreement;

1- I strongly disagree 2 - I disagree 3 - neutral 4 - I agree 5 - I strongly agree

No.	**Effects of site layout plan on labour productivity.**	Rankings				
		1	**2**	**3**	**4**	**5**
i.	By reducing double handling of materials					
ii.	By reducing the turnaround time in execution of any task					
iii.	By improving the quality of work because materials are well stored and therefore have little or no defects					
iv.	Availability of plant and equipment and are well located					
v.	By improving on safety (less or no injuries)					

vi.	By improving security through signage, effective communication, fencing and hoarding, clearly define access ways Preventing vehicular - human conflict.					

APPENDIX III

TEMPORARY FACILITIES PROVIDED ON SITE

Facility No.	Facility Name
1	Job office
2	Owner representatives office
3	Subcontractors office
4	First aid office
5	Information and guard house
6	Toilet on site
7	Staff/Engineer dormitory
8	Staff/Engineer family dormitory
9	Labour dormitory
10	Labour family dormitory
I I	Dining room for labor
12	Bathroom for labor
13	Restroom for labor
14	Equipment maintenance shop
15	Parking lot for mechanics
16	Prefabricated rebar storage yard
17	Rebar fabrication yard
18	Fabricated rebar storage yard
19	Carpentry shop
20	Storage yard for lumber
21	Storage yard for formed lumber
22	Cement warehouse
23	Batch-plant and aggregate storage
24	Craft change-house
25	Sampling / Testing lab
26	Pipe jointing yard
27	Pipe storage yard
28	Welding shop
29	Parking lot
30	Tank
31	Long term laydown storage
32	Machine room
33	Electrical shop

34	Steel fabrication shop
35	Sandblast shop
36	Painting shop
37	Scaffold storage yard
38	Material warehouse

APPENDIX IV

CHECK LIST OF TEMPORARY FACILITIES PROVIDED ON THE SITES

NO	FACILITY	CONSTRUCTION SITES																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	Site office engineer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
2	Site office consultant	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
3	Site office Clerks of works	✓				✓	✓	✓	✓				✓	✓	✓	✓			✓	✓							✓		✓			
4	Info. guard room	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
5	Safety officers office	✓	✓	✓			✓	✓	✓						✓		✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
6	Meeting /conference room		✓						✓						✓		✓	✓								✓	✓					
7	Site accomm.								✓																							
8	Sanitary areas		✓	✓	✓	✓	✓	✓	✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓		
9	Changing rooms								✓																							
10	Canteen		✓						✓						✓	✓							✓									
11	First aid/clinic								✓						✓								✓									

NO	FACILITY	CONSTRUCTION SITES																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
12	Equipment workshop	✓		✓					✓				✓			✓		✓	✓							✓					✓	
13	Steel fab. area								✓																							
14	Carpentry shop	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
15	Storage for cement	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	
16	Storage for lumber	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
17	Storage for plumbing materials		✓		✓	✓			✓	✓	✓			✓	✓		✓		✓	✓	✓	✓		✓		✓		✓	✓	✓	✓	
18	Tools room		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	
19	Sampling/testing lab.						✓		✓																							
20	Electrical shop																															
21	Scaffold storage yard	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	
22	Ware house	✓		✓		✓	✓	✓	✓				✓	✓	✓	✓			✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	
23	Waste handling areas	✓	✓						✓							✓				✓												
24	Vehicle parking lot	✓							✓																							

PLATES

PICTURES OF SOME OF THE SITES VISITED

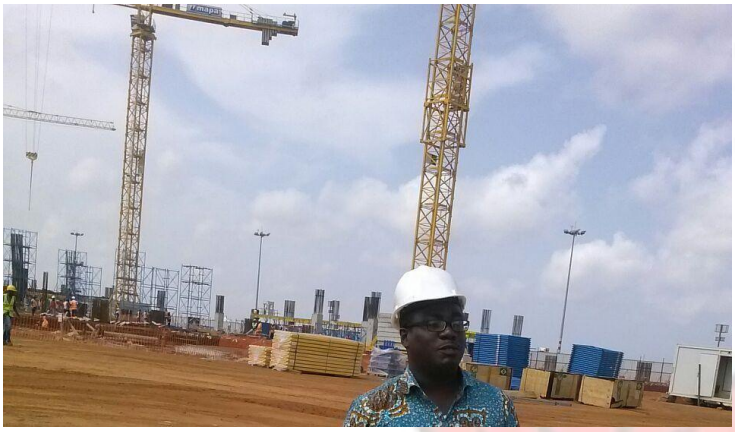

Plate 1: Some materials and equipment

Plate 2: Men at work in the background is the fence bounding the site

Plate 3: Men at work in the background is a crane tower

Plate 4: A place for eating, in the background is the fence bounding the site

Plate 5: Some aggregates strategically located closer to the mixer

Plate 6: Steel members left in the open on the bare ground

Plate 7: Site office and accommodation with some formwork

Plate 8: Site offices