KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

DEVELOPING GUIDELINES FOR ACHIEVING STANDARD LABOUR OUTPUTS FOR CONCRETE WORKS IN THE GHANAIAN CONSTRUCTION INDUSTRY

BY

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DECLARATION

I declare that I have wholly undertaken the study reported upon here-in under supervision".

……. Date…….

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(Student)

I declare that I have supervised the student in undertaking the research reported herein and I confirm that the student has my permission to present it for assessment.

……. Date……

Prof. Edward Badu

(Supervisor)

I confirm that the student has duly effected all corrections suggested by the examiners in conformity of the Departments requirements.

……. Date……

Dr. B.K Baiden

(Head of Department)

DEDICATION

To my father and mother, the late Alhaji Hashim Ahmed and Hajia Salmata Abdulai.

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ABSTRACT

The construction industry is considered as capital intensive industry and driven by its major resources such as Labour, Materials, Plant and Tools. These resources must be properly planned before initiating a project. Out of those resources mentioned, the one considered under this study is labour. Many projects in Ghana and over the world have suffered from delays of projects and unreasonable cost overruns due to several factors which spans from non-achievement of standard labour output during construction stages and unrealistic duration during planning stages. This research was aimed at developing guidelines to achieve standard labour outputs used for concrete works in the Ghanaian Construction Industry and to establish an innovative way of measuring output during construction for effective and efficient labour output. It specifically studied the standard labour output to concrete works currently achieved on site by the contractors, the challenges faced in achieving these outputs and recommended guidelines to effectively achieve improved outputs. The study was done on a selection of 40 Contractors involved in the construction of buildings and other civil works in Greater Accra Region of Ghana. Data generated from the survey was further analyzed using descriptive statistics (percentages, tables etc.) and relative importance index (RII). The research was able to identify *three* highly important practices to serve as a guideline in achieving standard labour outputs for concrete production and delivery which include; *continuous flow of materials, setting target for workers and increasing crew size in complex formworks*. The study also found out that, most contractors in Ghana find it difficult in achieving the standard labour output due to numerous challenges. The study was able to establish that, *low wages, changing of crew members, equipment breakdown, complexity nature of formwork and incompetent supervisors* were the five major challenges to non-achievement of standard labour output faced by

contractors in Ghana during concrete works. However, proximity to materials, morale and attitude of workers, poor co-ordination of work and materials and tools shortage were the least challenges to achieving standard labour output in Ghana. It was recommended that contractors should constantly study the guidelines identified in this study to maximize their labour output during concrete works on site, attend refresher courses to equip themselves with effective management of labour, development of work pack ticket which is a sheet of paper designed by the site engineer outlining all the works to be carried out the following day including targets set and discussing set targets with workmen before activities are carried out.

Key words: Guidelines, Standard labour output, challenges, Ghana.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER ONE

GENERAL INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The construction industry in Ghana has revolved over decades making it more competitive with complex structures springing up to replace simple and outmoded structures. The optimum aim of procuring a construction service to the client is to meet the physiological needs of man for shelter and mobility. However, to enable a client to procure this service depends on how much it will cost him. Cost is the prime and most imperative question to ask by clients previously capitalising the period and capital prerequisite to advance an idea into an understood plan, and responding wrongly at the conception stage will certainly prone to cost invades and time delays far along down the road. The industry is considered as huge and capital intensive driven by its much resources such as labour which need much attention to be critically examined before initiating a project (Han et al., 2008). Out of these resources mentioned, the most essential one considered under this study is labour.

Labour-based projects however are most entirely dependent on the output of labour. In order to plan and carry out labour-based work effectively, it is essential to have a realistic estimate of expected labour productivity. Productivity of labour is a measure of how much work executed. The ratio of productivity is well-defined as the total out-put per unit of the total input. In building, the productivity is measure in weight, area, volume and length whiles the input resource is generally the cost of labour or man-hours (Intergraph, 2012). Every year, Contractors and their respective clients in Ghana are hit with construction claims worth billions of cedis affecting labour out-put. Building claims such as Liquidated and ascertained damaged (LAD), poor workmanship, variations, cost overrun, cost emerging from structural defect etc. are often

due to poor planning. Construction Managers, Engineers and Quantity Surveyors in the Ghanaian construction industries sometimes use standard labour outputs during planning and scheduling. This often results in setting standard targets. Much research has been undertaken in the Ghanaian construction industries which has established standard labour outputs but due to the unique nature of the industry which changes from one project to the other, the standard norms varies as well. Meanwhile, much has not been done to clearly define suitable guidelines in achieving standard outputs.

Thomas *et al,* (2005) remarked that construction productivity is a cause of great concern in both the construction industry and academia. The emphasis on construction productivity is associated with the important contribution of the industry to the national economy and the reported problem of low productivity in the industry. Many researchers have reported a decline in construction productivity (Hewage and Ruwanpura, 2006; Veiseth, and Andersen, 2003). Lawal (2008) reported that construction workers in Nigerian public service have almost zero productivity. Guidelines to construction labour output aim at identifying the challenges leading to the non-achievement of these standard labour outputs and further elaborate on procedure and methods to enable outputs to be successfully achieved. These will remain relevant to the industry for monitoring and evaluation purposes.

1.2 PROBLEM STATEMENT

In Ghana, a lot of construction projects end in dispute because contractors are unable to meet time lines. Construction projects are generally unique and are built on sites with different work crews associated with different trades, level of education, religion, ethnicity and weather changes. Thomas (2004) points out that, only a third to one half of operative‟s time is spent directly on work activities productively. Key factors that affect labour productivity in

construction have been obtained from works by Kaming (1997); Olomolaiye (1998); Enshassi, (2007); who stated that the critical factors for increasing labour productivity in developing countries differ from that in developed countries. In the construction industry of developing countries, productivity loss is one of the greatest and severe problems arising from lack of documented data for estimating, scheduling and control of the project. Concerns over no accurate measures of labour productivity data for the industry and its sub-sectors have been constantly raised (Chapman and Butry, 2008).

Lack of measured data hinders the performance and the development of the industry. Also research on productivity and performance of the construction industry has been limited. In separate studies, Kaming *et al*. (1997) and Hansson (2007) discovered that another problem associated with construction labour productivity is the possibility of its variation across geographical locations. Fluctuations to labour output rates in the construction industry has remained a big challenge to developers and contractors in their decision-making processes over decades in the determination of activity durations and consequently, inadequate estimation of contract periods (Wachira, 1999). Despite the concern on lack of data for estimation, little research attention and documentation has been undertaken on construction sites to establish home grown data for planning, costing and budgeting in the construction industry in Ghana. Attar *et al* .(2012) noted ineffective management to be a primary cause of low labour outputs and identified a lack of alignment among goals, contractual conflicts, difficulties in measuring productivity, weak commitments to continuous improvement and a lack of labour force focus as barriers to improving labour outputs. High improvement in construction labour output levels can be achieved if roadmaps to improving labour outputs are clearly established and measures are taken by all stakeholders to adhere to these roadmaps to the benefit of stakeholders. To

overcome the challenges faced by contractors, there is the need for the development of guidelines to guide contractors in achieving the standard labour outputs to help prevent failure of projects executed across the country from meeting timelines.

1.3 RESEARCH AIM

The aim of the study was to develop guidelines for achieving standard labour outputs for concrete works in the Ghanaian construction industry.

1.4 RESEARCH OBJCETIVES

In achieving the aim, the following were the specific objectives:

i. To identify the existing standard labour outputs for concrete works in the Ghanaian construction industry; ii. To identify the challenges faced by contractors in achieving standard labour outputs for concrete works; and iii. To develop the most appropriate guidelines for achieving standard labour outputs for concrete works.

1.5 RESEARCH METHODOLOGY

The research was conducted through survey questionnaires. Survey is one of the most cost effective ways to obtain information from large pool of people given better results more specific, accurate, faster and most cost effective ways (McQueen and Knussen, 2002; Farag *et al.*, 2009). The companies surveyed were building and civil Engineering construction firms in financial class D1K1 –D4K4 of the Ministry of works and Housing Water Resources. At first, the study commenced with a thorough literature exploration of both the electronic and hard

copy media. Questionnaires were developed and conducted among top management officials and professionals in the contractor organizations who are involved in the construction process and administration. A number of comments and suggestions from an initial pilot study was conducted and the feedback used to amend the questionnaire before final distribution. The data collected from the questionnaire survey was analysed using descriptive statistics through the use of Microsoft excel 2007 and Relative Importance Indices (RII) techniques used to rank the results.

1.6 SCOPE OF THE STUDY

Geographically, the scope of this research was limited to the Greater Accra Region located in the Southern part of Ghana. Because of the rapid growth in infrastructural developments, many contracts have been initiated and a lot of contractors been awarded with various contracts. However, Accra which is the capital city of Ghana and is characterised by flew of construction companies who are in active business. Most of these companies are Small and Medium Scale Construction companies which have the entire prerequisite and possess vital characteristic to enhance our research work. These the operation of contractors in Ghana are largely biased towards the city capitals with more than 70% of the registered Building and Civil engineering Contractors, particularly the large organizations, tend to operate officially in the Greater Accra region and Kumasi whilst the remaining eight regional administrations put together account for the remaining 30% (Ayisi, 2000; Ahadzie, 2007).The study was restricted to Building construction companies with Ministry of Works and Housing Water

Resources financial classification.The study extensively covered a few but active construction sites within the region and it is our hope that all information obtained from the field gave clear and true reflection of what is existing on grounds.This research was confined to concrete trades

in the Ghanaian construction industry. The study identified the existing labour outputs, the study also identified challenges to non-achievement of standard labour outputs and finally developed the most appropriate guidelines for achieving standard labour output for concrete works.

1.7 SIGNIFICANCE OF THE STUDY

This study is important to the construction industry and all relevant stakeholders in Ghana to serve as a roadmap to achieving standard labour targets. And to the construction managers, as a guide when making an informed decision on project scheduling, monitoring and control. The Government of Ghana being the largest initiator of construction projects will be informed by this study on how timelines of construction projects are furring in order to communicate effectively to the donors.The outputs produced by this study will promote a greater awareness and a deeper understanding of appropriate guidelines for achieving better results and performance measurement.

1.8 ORGANISATION OF THE STUDY

The study was organized in five chapters. Chapter is the introduction to the research. The background for undertaking the research is presented in this chapter. The statement of problem, the aim and the objectives were outlined. The chapter briefly describes the research process (detailed discussion follows in Chapter three). An outline of the study was also presented. Chapter two looks at the nature of the construction industry and how it lends itself to standard labour outputs, challenges to achievement of standard labour outputs, ways of prevention and their documentation. Chapter three describes the approach and discussed the methods used in achieving the objectives for the research. Methods and techniques used in data collection, analyses and interpretation are presented. Chapter four presents the analyses of the responses

obtained from the questionnaires and interviews. A general discussion of the results of the survey was undertaken Chapter five presents the main conclusions of the study and the achievement of the key research objectives. The recommendations, based on the main findings have been presented in the chapter with some potential areas for future research.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

In this section, a critical assessment of academic works regarding standard labour outputs for concrete works is carried out in hypothetical foundation to defining the guidelines for achieving standard labour outputs in concrete works used in the Ghanaian Construction Industry. The definition, principles, dimensions and explanations for labour output are all examined. The chapter concludes with how labour output in concrete works in the Ghanaian construction industry are achieved and the need for guidelines be introduced to enhance optimum the labour output.

2.2 THEORETICAL EXPLANATION OF LABOUR PRODUCTIVITY AND OUTPUT

2.2.1 Overview of Labour Productivity

The productivity of a building labour has been deliberated for the past years and this method is quiet actually developed. The frame was industrialized adopting statistics, but successively exited on to report difficulties related with this system by proposing options (Kim and Kim, 2001). Labour in building is frequently generally well-defined as output per man hour. As labour institutes a great measure of building cost and the measure of labour hours in execution an undertaking in building is prone to the effect of managing than resources or capital, this productivity extent is regularly denoted to as *labour productivity* (Rosefielde *et al.,* 1979). It further explained productivity as a relation of output to what is essential to be produced and conclude that the degree of productivity is well-defined as a total output per one unit of a total input. According to Dozzi and AbouRizk, (1993) labour productivity is the physical progress achieved per hour of a total work volume. They outlined that the two greatest significant actions

of labour productivity involve the efficiency that labour is used in the building procedure the comparative competence of labour responsibility what it is necessary to do at an agreed period and place. Though there involve unending meanings of the output of labour, but all denote to labour productivity or output as an evaluation of input vs. output. Labour productivity obliges as a foundation of economic advantage. Cumulative productivity drive intensification output or the measure of output and if at a quicker rate than competitiveness, profits will be attained over the value-added from the products (McTague, 2002). This explains the fact that much profit is accrued for a higher and quicker productivity which is more than the value added to the final product.

The study of labour productivity is classified into two classes: individual‟s approximation unit rates by means of an arrangement of dynamics that distress labour productivity; and individuals who cogitate the influence of a distinct influence (or numerous issues) on productivity. The first group of classification of labour productivity refers to the building contractors who measures labour output in unit rates by approximating unit rates based on the foundation of task proceedings. It is however, imperative to memo that labour efficiency is a quota of the complete efficiency of an operational classification in developing the labour, kit and funds to translate labour exertions into valuable productivity, thus, is not a measure of the competences of labour only. Meaning that, at the end of each task, the labour receives certain level of training which develop his skills and also measures his competence. For instance, by capitalizing in different equipment to accomplish definite jobs in building, output can be enlarged for the same amount of labour times, thus ensuing in advanced labour efficiency.

Productivity has been defined differently by different authors. Commonly, productivity is well-defined as the output produced per unit of resource input. According to Hanna (2005), productivity refers to the ratio between the total quantities of input (in terms of resources

consumed) and that of output (in term of finished product). This definition might change slightly depending on what productivity is being measured and for what purpose it is being done. For example, Song and Abourisk (2008) explained that productivity on site is measured differently during different phases of a construction project depending on why this is being done, the level of detail that is required as well as the availability of resources that can be used. Productivity measures are also part of the balanced score card system and generally rely on some indicators of output per employee (Litschka, 2006).

Labour efficiency in financial side denotes to quantify output after construction practices, per unit of input. Labour efficiency, is usually measured as a relation of output per labour-hour of input. Labour efficiency is distinctive from measures of involved recognized competence, that involve both the value of produced and the rate of efforts castoff. At the same time, it is separate from profitability measures, which report modification in the middle of the proceeds attained from production with the expenditure related with intake of inputs. (Saari, 2006*). In actuality, labour efficiency is further* explain on fairly different dynamics like site conditions, workers‟ capability, materials obtainability, climate, enthusiasm, management, etc. Management have emotional impact on labour efficiency. According to Ganesan (1984), ineffectual managing of business and its building activities, without public or private, is a major source of ineffective productivity. Regularly, labour efficiency is influenced by lack of capacity of numerous establishments to accomplish their development objectives, and involve, profit boundary. Consequently, it‟s comprehend the core factors of labour efficiency, and to retain and associate precise proceedings of efficiency intensities through projects. Productivity results in modest advantage. Cumulating labour productivity will upsurge output if at a more rapidly degree. In rivalry, profits can be accomplished from the value-added (Mc, Tague, 2002).

2.2.2 The Trends of Labour output in the Construction Industry

Measuring labour output for the construction industry is difficult. Labour output in construction has various expressions covering performance from industry to individual crew members (Oglesby et al. 1989; Thomas et al. 1990; Rojas, 2008). Commonly, Labour output is defined as the output produced per unit of resource input. In the construction industry, the resource input is usually addressed by the time needed to complete a unit of output, and the unit of output is chosen based on the purpose of conducting a productivity study. Therefore, labour output has various expressions which correspond to the different focuses at the hierarchical levels of construction. Because of different types of output involved, monetary values are commonly used to combine the output at the organizational, project and activity levels. However, this monetary method is not an effective way to evaluate field productivity at the operation, process and work task levels, where the number of units completed is used for the output (Rojas, 2008). As stated earlier, Labour productivity can be defined in different ways depending on the purpose of measurement. Dynamics disturbing building and labour efficiency contain capitals (materials, info, implements, kit, labor force skills, and services provision), the excellence of on-site management, project managing, work flow sequencing, climate, and security (P. Goodrum, 2009). It is not suitable to quantify the building industries depending on some efficiency extents, as it is a multifaceted. when sedated on the foundation of labour efficiency current statistics by Statistics Canada for the building sector from 1997 to 2002 depicts an regular rise of 1.9% per annum (with a reduction in 2001 of -2.3%) however the rest of the country's budget enlarged at an normal of 2.3% per annum (Haas, 2009).

2.3 EXISTING LABOUR OUTPUT FOR CONCRETE WORKS IN THE GHANAIAN CONSTRUCTION INDUSTRY

In Ghana, Construction output is conveyed based on well-designed units. Previously, labour efficiency relates to units of product per labour time, such as cubic meter of concrete placed per hour. Concrete are measured in cubic metre hence the expected labour output is how much concrete poured per cubic meter obtained and measured in unit per labour hour of the total volume. Base on frequent field experience and observations, a cubic meter of concrete is rated to be batch and placed in less than half an hour for a head count of twelve gang men with a labour distribution of;

Loaders	5No.
Mixer operator	1No.
Concrete conveyors to pouring site	3No.
Masons to placed concrete and tamp	2No.
Carpenter to fix opening formwork	1No.
Total gang men	**12No.**

The expected time to pour a cubic meter of concrete for the above labour distribution is recorded with a concrete mixer efficiency of 0.67 cubic metres per discharge to be between 35-45minutes maximum. However, this phenomenon doesn‟t hold in most cases due to the unique nature of construction project which varies from one site to the other. This challenges the average Ghanaian contractor in developing ways to achieve or optimise these outputs. To most quantity surveyors, these are the assumptions of building up rate per cubic meter of concrete but to the contractor, pose a challenge of how to achieve this outputs in concrete production.

2.4 CHALLENGES TO ACHIEVEMENT OF STANDARD LABOUR OUTPUTS IN GHANA

Various factors have been identified by different researchers in different construction industries. Most of these researches were carried out in the developed countries and a few developing ones as: Canada (Jergeas 2009), UK (Chan 2002), New Zealand (Durdyev and Mbachu, 2011) and developing countries such as Nigeria (Olomolaiyeet al., 1988; Ameh and Osegbo 2011; Adamu et al. 2011), Indonesia (Kaming et al. 1997; Alwi, 2003).

Largely, labour output is affected by outside and inner influences, representing ones separate from the mechanism of the organization‟s management and the ones inside the firm respectively. In a study by Enshassi et al. (2007) of issues negatively thwarting labour output in the Gaza strip, it was advocated that the 10 greatest imperative elements negatively thwarting labour efficiency are: material shortages; inadequate labour knowledge; lack of labour surveillance; confusion between labour and superintendents; drawings and design changes during the execution project; delay payment; scrutiny interruption; functioning seven days per week deprived of holiday; and tool/equipment deficiencies. In Thailand, Makulsawatudom and Emsley (2001) recognized six important influences affecting on labour output as follows: inadequate material, management interruptions, inadequate machinery, modify; absence, and intervention. Studies of craftsman productivity in Indonesia, Kaming *et al.* (1997) branded inadequate materials, as a result of work mishandling and inadequate machinery as the chief efficiency difficulties. In a comparative assessment of labour productivity problems in Indonesia, Nigeria, United Kingdom and the United States, Kaming *et al.* (1997) perceived that inadequate materials are a shared of difficulty in the four nations. In Nigeria, a study by Olomolaiye et al. (1987) acknowledged the succeeding difficulties manipulating craftsmen‟s

labour outputs in edict of rank: inadequate materials, inadequate machinery, and replicated exertions, coaching delays, examination delays, incapable manager, and altering team fellows. In Nigeria, low wages were placed top thoroughly shadowed by inadequate materials and unfavorable climate (Adamuet *et al*. 2011). Late advent of materials or labour, equipment break-downs, poor lay out of work plan, and inability to deliver info will result to down time (Thomas and Raynar, 1997 in Mojaheed, 2005). In New Zealand, Durdyev and Mbachu (2011) testified on the restrictions with the uppermost influence on efficiency as modification, the workforce level of experience, suitability of system of building; build ability matters, and derisory management and direction.

Labour output is the utmost imperative of the factors that influence general presentation of any small, medium or big building company. Issues which openly affect labour output in concrete production accordingly is it‟s vital for any institute to revise and recognize those influences and proceeds a suitable act for advancing the concrete production. If labour output in concrete production is improved, untimely it lessens or drops the unit cost of the project and stretches over all greatest act of the project (Khaled, 2011). The labor force is the greatest treasured advantage, which accounts for over a quarter of the entire development cost (Han et al., 2008). In addition, workforce has remained one of the greatest challenge to manage in this activity which when overcome, one can automatically manage all other resources during concrete production and placement. In driving the workforce to achieve target, guidelines needs to be developed and be guided with. Other major challenges to developing a guideline for labour output to concrete works are the use of equipment, work features, materials, and managing and mechanism. These components indirectly influence labour productivity by influencing the work of the workers.

Concrete production in the built environment is labor-intensive and depend profoundly on the staff capability.

2.4.1 Moral and Attitude Spirit of workers.

Founded on readiness, sureness, correction, and merriment to carry out task can be dropped due to a diversity of subjects, counting augmented battles, arguments, extreme dangers, intensely, over-inspection, numerous agreement variations, disturbance of effort regularity, poor site situations, absence, frowzy workstation, etc.

2.4.2 Management factors

Personnel management practices have a great impact on labour outputs. Poor staffing arrangement inadequate supervision and crew turnover have a negative impact on the outputs of such work. In a study by (Bennet, 1990) poor coordination was noted to be a factor to low output rate of labour surveillance, misunderstanding between labour and supervisors

2.4.3 Mismanagement of time

Misuse of times on site has always led to non-achievement of standard labour outputs.Labourers are not able to stick to times schedules, they start work as they wish, talking among themselves in the recent development, labourers use working hours discussion political issues, local and foreign sports. In most site, targets are less set for operatives so whether standard established outputs are realized or not they care less.

2.4.4 Weather condition

Weather condition is considered as an external factor to standard labour output. However, it is a critical issue to be looked at tendering and estimation stage, this is always forgotten but a critical factor in achieving labour outputs. Weather condition at different condition has a great impact on the outputs of work. Adverse weather such as in the winter, raining season reduces labour outputs disruption may stem from weather events, geographical climate change. After this occurs, mobilization, orientation of labour force becomes a great impact on the results of works. Building schemes, are performed in an outside location, and consequently are thwarted by conditions of the weather. Climate influence was stated to be chief influences producing postponement and cost on building developments. (Baldwin et al., 1971). Substantial amount of building doing execution of a task in an alteration of period and, temperature zone, climate change resulting in work completed and also precise hot or actual cold climate, rain or snow or further variations in temperature or weather can influence workforces outside usual situations. Majority of crafts do not work in the rain in Ghana unlike others in wet regions of a country hence risk losing too much wages. This is due to poor visibility, discomfort, and hazards and thoughtful to climate circumstances. Benjamin et al. (1973) advocated that nearly 50% of building during construction are subject to climate circumstances. The influence of climate on building can be in the custom of abridged labour efficiency and (or) work stoppage. Abridged labour outputs and usually credited to abridged human act due to heat or cold pressures subsequent from the joint result of temperature, humidity, and wind velocity. Climate-related work stop-page is credited both to the incapability of building workers and labour force in plain climate situations of heavy rain, snow, etc. Construction in varied season and, temperature region, weather variation affect work

accomplished in both very hot and very cold weather, rain or snow or other vagaries in temperature and weather can influence labors outside usual situations.

2.4.5 Material and tools shortages

Construction industry in the Gaza Strip acknowledged five greatest central influences that influence work productivity and this include; material deficiencies, lack of knowledge of labour, lack of labour scrutiny, and modification of drawings design throughout implementation. The major categories of factors in Dai et al., (2009) study of craft worker‟s perception of 83 factors that affect their productivity in the US revolve around obtainability of tools and consumables, materials, building equipment and engineering drawing management. Materials shortages; Logistics inadequate or poor materials handling or shortage, owner-furnish materials, procurement practices, or a lack of control can source obtaining or delivering difficulties and subjects. This causes delay, or disturbs the usual materials work process to work zone.

2.4.6 Lack of information on target outputs

Olomolaiye et al. (1998) fleet deliberate labour efficiency on building locations in Nigeria. Their reading established that there was a requirement for creating production statistics on numerous building locations over time study methods. It was decided that technique readings and investigation consequences must be dispersed not only to big companies however to small and medium companies so the greatest industry occupied systems can be accepted by workers, ensuing in improved productivity lacking unavoidably cumulative bodily exertions.

2.4.7 Types of supervisors and Management factors

In Ghana supervision has always been a big challenge. Supervisors *are* responsible for procurement, organizing, and applying a diversity of vital capitals to donate to an officialdom‟s achievement both efficiently and capably. Supervisors are considered *best if* they attain their objectives with a reduced quantity of capitals for the quantity of outputs created. *Managers* dedicate a big fraction of their exertions to scheduling, establishing, recruitment, foremost, and regulatory the activities of human and several capitals. Ineffective managing is mentioned as a main source of inefficient productivity fairly than other influences. Leadership and coordination factors are considered the most critical tool in achieving standard labour outputs. To create an environment for optimum labour output, supervisors must understand and minimise theses destructions within their control. They can create a proper a proper working environment by providing adequate resources, proper sequencing activities, effectively organising the site and limiting work content change.

2.4.7 Motivational factors

Lack of motivation to employees contributes to low output rates in Ghana. According to David Mann (1989), operational incentive recovers labour productions as it upsurges production and decreases budget. Motivation raises the value of incentive be contingent on how one cravings it. The level of fulfilment to the rewards, therefore, influence the level of incentive to do (Bohlander, 2010).

2.4.8 Deviation from plan

Alteration is one of the rare factors in a development that a project manager can be selfassured will exist. From the AACE Worldwide, a modification is distinct as a change or dissimilarity to a space of task and/or the program for implementing the task (AACEI, 2007). In several building schemes, in totaling to the alternative of the new possibility, other variations always exist. Variations, which are un-usual or cooperatively directorially recognized in the practice of alteration instructions, happen for numerous explanations on building projects. When these happens, labour activities are brought to a hault thereby affecting daily outputs.

2.4.9 Weakening of Supervision

This happens when management is unfocussed from industrious, premeditated, and program activity to examine and disposition agreement variations, accelerate overdue resources, and accomplish additional teams or other variations not in the unusual task possibility and plan. Weakening also is instigated by an upsurge in manpower, task zones, project scope starved of an upsurge in direction.

2.4.10 Work overload

Most sites in Ghana thus observe additional working hours to make time for the lost time. This might reproduce employee‟s effort or promise to the work, workstation, client or task potency and the confidence of reaching advanced present or upcoming remunerations, around certain plug, lengthier occupied periods unavoidably commence to make hazards and period battles that delay not only with the excellence of non-work

lifetime, nevertheless on-the-job act. In totaling, when measured in an extended period prospect and as of wider standpoint, efficiency and the company‟s labour expenses may be influenced in numerous unintended conducts. Flexible workstation does meaningfully lessen the life-to-job spillovers that damage worker‟s production at the workstation. This embraces between hourly personnel, plus individuals at the admittance stage (Bond and Galinsky, 2006). Extended occupied times have an opposing influence on employee well-being, due to exhaustion and work pressure (Golden et al., 2011), they incline to retain labour efficiency less its probable. “Overtask” is viewed as growing threat that an employee will involvement indications of exhaustion and task pressure, which would weaken one or the other the short-term or long-term efficiency level of employees or companies. Present approximations of the overtasked discover that nearly 3 in 10 American employees account lately sensation overtasked and that around half of employees impression they have been “overtasked” at nearly point in the past three months (Galinsky et al., 2005a).

2.4.11. Absenteeism

Labour absenteeism in construction has also been one of the challenges affecting labour outputs. Position at 41 of the issues adversely thwarting worker productions outcome can be acceptable, assumed the fleeting view of the native employees and the comfort with which building servicers can employ extra worker to shelter absence. Building projects are typically labour-intensive with rudimentary hand equipment, as work

charges include 30 to 50 % of general plans expenses (Guhathakurta and Yates, 1993). Consequently, though many building worker efficiency investigation readings have remained assumed, merely a little have lectured the efficiency issue in emerging nations. In a similar studies the period of times for each worker is probable to supplement to the stage of output per employee, however prepares it really advance the worker frequency of labour? In the US, extensive times can be allied with superior productivity, in an assumed business, however they are also related with reduced production for each hour, at minimum for the period 2000-2005. Though, Shepard and Clifton (2000) recognized that industrial efficiency does not essentially advance when times are elongated. Their pragmatic reading of combined board information for 18 industrial businesses in the US economy proposes that the adoption of strenuously times really drops regular efficiency, quantified as output per labour hour, for nearly the businesses in the tester, even when the data are measured or modified. More accurately, a 10% upsurge in strenuously occasioned, on regular, in a 2.4% drop in efforts sedated by hourly output. Absence and Income; there is a countless agreement of period and money misplaced related with high income and absence on projects.

2.4.11 Frequent changes to design drawings

This relates to changes to original scope which causes resigning and movement of resource on and away from project site. This leads to disruptions of smooth project progress which often result to delays. Labour out-put drops throughout this period as time is lost when work squads are change from one area to the other. In conclusion, there

has been much work identifying the factors that leads to non-achievement of labour out-put. However, unsuccessful managing has been mentioned as a main cause of low labour outputs rather than others factors which leads to non-achievement of labour out-put (Khaled, 2011).

2.4.12 Type of formwork and complexities

Element which define formwork constructability are called system formwork. Geometrical shape, size, and orientation retard labour output in casting. These system are very difficult to work with. Crew members spent much time in the casting these forms making the overall output less than expected.

2.5 LABOUR OUTPUT IN CONCRETE WORKS

Issues around labour output in concrete are progressively the consideration in the built environment (Haas et al., 2000). Labour is measured to be the greatest indeterminate feature amongst expensive scheme mechanisms. The new constituents, materials, and equipment, are mainly resolute by market fees, and are therefore further than the effect of project management. When a firmness of a building plan is essential, builders need to choose a suitable way of actual creation and location that can speed up the plan, though reducing the cost. Such approaches happen. Normally, a builder originally upsurges the on-site work force (Hanna et al., 2008). Worker output is measured to be the greatest pointers of actual construction competence.

Advanced efficiency typically produces greater effectiveness. Advancement in technology has prepared it informal to build multifaceted solid erection. Although a lot of equipment, plant and tools are castoff in the making and location of concrete, the degree of production is not a measure of the competences of labour alone but goes beyond the entire operation by measuring the total utilization of labour, equipment and capital to convert labour efforts into useful output. There is silent much room for additional reading in this extent (Rojas and Aramvareekul, 2003).

2.5.1 Measuring standard labour output

In general, measuring labour output over time can provide useful information to evaluate the effectiveness and efficiency of a system, an operation or a process, and also allows managers to implement a continuous improvement program toward high performance and cost savings. However, in the construction industry, labour productivity has always been exact challenging to quantify and regulate (Jaideep et al., 1995). All approximating specialists would come to an agreement that the measure of task to be executed and the cost per hour for labour to execute that work can be recognized with substantial correctness. Jaideep et al. (1995) further added that it is the recognizing and assessing of the acute influences which effect worker productivity that offers a problem. All faults in productivity approximation result in a transposed consequence in the real cost of labour to execute a scope of task.

Labour output development can be regarded as an unremitting and systematic managing procedure which suggests variation. Firms, and specifically the estimators in the firm, need to study to prediction systematically an accurate productivity price in directive to be modest and to endure in present's tendering environs. Baumol and Mandela, (1990) identified the vagaries in the excellence of equipment, materials or labour as acute influences of worker efficiency depth. They suggested that excellence variations in employees, materials or equipment are

frequently tangled as donors to true worker efficiency weakening or improvements, and also suggest that quality must be looked at separately from the issue of true productivity improvements or decline In construction, trade productivity is usually defined for conceptual and analytical simplification as the ratio of the output in a particular trade as related to the tradesman‟s inputs and can be expressed in quantitative terms as physical productivity. Wang (1999) and Abd*et al*. (2008), however submitted that it is imperative to stipulate the input and output to be quantified when computing output of a labour since there are numerous other inputs like equipment, materials, tools, resources and design to the construction system while the change procedure from input to outputs related with construction operations is also multifaceted. The complexity arises from the fact that the conversion process is inclined by the know-how used and by various externalities such as administration principles, climate, union activities, financial circumstances, managing and by many environmentally friendly modules. Even for a process like concreting, with distinguished work procedures and equipment construction productivity estimation can be thought-provoking, due to the distinctive study necessities and variable setting of each building project as well as the complexity of the influences of job and managing issues on operational efficiency (Ok and Sinha, 2006).Yardsticks are usually employed for measuring the productivity of concrete placing by giving the placing labour or equipment productivity as the relation amid the amount of concrete placed to the man-hours (mh) or equipment hours (eh) dedicated by the employing gang or tools respectively, the mixer efficiency as the ratio among the quantity of concrete placed to the mixer-hours spent on site (Wang, 1995; Anson*et al*.,1996). Concreting productivity consequently entails relating a single input (worker-hour or equipment-hour) to a single output (concrete volume in m3) and the simple productivity ratio of this input and output is calculated assuming a closed system with all other factors held constant except for the desired input and

output (Wang,1999). Such productivity measures relating output separately to each major class of input proportions reflect changes in these input proportions as well as changes in productive efficiency and allow organizations to analyze the changing costs of the inputs when combined or when separated in terms of both their prices and quantities. The overall (total factor) productivity for an entire concreting operation, which is the placing rate, is thus appropriately measured as the ratio of the quantity of concrete placed to the total time of the operation in cubic meter per hour while the labour productivity is measured as operative hours per unit of work, or wh/m3 of concrete (Proverbs et *al.*, 1999); (Dunlop and Smith, 2003).

2.5.2 Developing Guidelines to Labour Output

For the preceding 20 years, labour output is a matter of argument in the built environment. Conferring to a current piece in the Civil engineering periodical (Bernstein, 2003), building professionals have determinedly scrutinized the postulation that production in the building industry holdups overdue than other businesses. It is extensively apparent that worker efficiency in the developed nations in the building area has progressively waned ever since the 1960s. Readings accomplished in the 1980s stated that the actual output per task period in this sector had weakened by a yearly proportion of 2.4-2.8% amid 1968 and 1980 (Dai et al., 2009). This is due to the fact that building worker efficiency is inclined by many issues whose influence can be measured in efficiency prototypes. Developing guidelines to labour output drama an imperative character in approximating cost, in planning, and in scheduling. A total of frame works and prototypes have been established expending regression analysis to afford a qualitative assessment of the influence of diverse features on building worker efficiency (Sonmez and Rowings, 1998). The current reading proposes to measure these dynamics and to

afford guidelines for forecasting workers efficiency to concrete production and placing. Concrete production and placement, is one of the major activities in the industry, is susceptible to all kind of internality and externality crash which has been renowned by many academics covertly for its energetic and complex view. In the subject of building managing, building target is to attain the goal of having the construction accomplished on time, within cost and accomplishment of the uppermost excellence (Dai et al., 2009). Fluctuations in labour productivity rates in the construction industry have remained a big challenge to developers who are constantly finding other means to achieved targets and over its associated challenges. These challenges to some extend can be remedy through established guidelines to labour output which contractors in their decision-making processes can rely on in the determination of activity durations for effective planning and inadequate estimation to contract periods. Managing labour output can be effectively achieved through developed and established guidelines for various works such as concrete production and placement. Positive delivery of project needs execution of managing arrangements that will permit the delivery of project players to regulate alterations in the main of scope, costs, plan, and excellence. Guidelines in construction productivity levels will serve as a roadmaps to improving labour outputs if clearly established, and processes due fellow diligently with all measures taken into consideration by all stakeholders.

2.5.3 The Importance of Guidelines to Achieving Labour Output

The principal aim of developing a guideline in achieving standard labour output in concrete works is to give the builder good value for time spent on deploying labour to a project which is thoroughly executed, of acceptable form and well-matched to accomplish it functional requirement combined with economical virtue and layout. Austen and Neale (1984) state that, the main purpose of developing a guideline is to be active in controlling labour output and

efficiency during project execution and not just to record and register timelines. Moreover, this guideline developed is to guide construction professional to achieve optimum labour output in the industry as these still remains to pose as a challenge. The guideline also helps to measure standard labour output. Other opportunity is also identified to improve operational efficiency.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This section deals with the research methodology employed to carry out the study. A detailed discussion on the research method, questionnaire design and how it was administered, the process involved in data collections instructions, sampling technique, sample size and data preparation. The essence of adopting this method is to enable a critical examination to the existing labour output in concrete production in the construction industry, it associated challenges to achieving this output and to develop guidelines to improve upon this labour output to enhance effective labour output practices in the Ghanaian construction industry.

3.2 RESEARCH METHOD

The research method adopted to carry out this study was the quantitative research approach. Quantitative research involves the use of structured questionnaires with optional response of predetermined and a large number of respondents involved (Fugar, 2010). Data obtained in analysed using statistical techniques. The use of this research tool was to enables the researcher

to predict, explain and understand phenomenon. However, interviews and developed questionnaires were the means of gathering information pertinent for the study.

3.3 DATA COLLECTION AND DOUMENTATION

3.3.1 Questionnaire Design

The survey was planned to judiciously safeguard that it elicits valuable response to these questions and also overawed the limits of mailing questionnaire survey. This was accomplished by ensuing the suggested top practices supported and approved, Moser and kaltron (1986), Oppenhiem (1992), and Baker (2003). Such practice involves creating of questionnaire organized to flow without element of bias. Also the worden was chosen carefully to prevent as far as possible any confusion or ambiguity.in view of the nature of feedback being solicited it was resolved that the questionnaire was designed to close ended questions. The questionnaires consisted of multiple choice requiring tick –box responses.

The questionnaires were structured in such a way that respondents were able to answer easily. The set questionnaires were structure using the set of likert scale format with a five point response scale. A likert scale is a rating that requires the subject to indicate his or her level of agreement to a statement. In this type of questionnaire, the respondents were given five response choices. These options serve as the quantification of the participant‟s agreement on each question item. Below is sample of the designed quantification used in the questionnaire.

On most of the questions, respondents were asked to express their views on a four -point

Likert scale (from“1”to“4”i.e.from highly important to less important).

Table 3.1 Likert Scale Response Table

VALUE	RESPONSE
1	Highly Important
2	Important
3	Somehow Important
4	Less Important

Rated questionnaires with assigned weight to measure attitudes and beliefs of technical personnel‟s and respondents were developed and distributes to collect information regarding the opinion and understanding of technical professional in the construction industry about labour output to concrete production and delivering and how effective it can be practiced. The questionnaires were all categories as below:

1. Respondents information;
2. Challenges to achieving standard labour output;
3. Standard labour output for concrete works obtained on site; and
4. Guidelines to achieving standard labour output for concrete works.

3.3.2 Primary Source of Data.

The source of primary data was in a form of questionnaire and site observation, designed and administered on live building site. The primary function of the survey data was to collect

information that can be analysed, and inference made to produce conclusion about the most appropriate guideline for achieving standard labour outputs.

3.3.3 Secondary Source of Data

The sources of secondary data were information from published text such as academics periodicals, research journals, government publications, dictionaries, past dissertations and Internet resources.

3.3.4 Piloting and Testing of questionnaires

According to Weisberg et al. (1996), questionnaire construction is art, much of which is learnt of which learnt through practice and that it is so difficult that researchers rarely use a questionnaire in a survey without first testing it. After series of reviews of draft questionnaires, a decision was taken to pilot the questionnaire before developing the final version. In the pilot survey, ten respondents were asked to comment on the questions with regards to its clarity and practicability of its completion by respondents. The response and comments received were revised and a number of revisions involving deleting, adding and rewriting questions made to the questionnaires for developing the final version of the questionnaires. A copy of the final version of the questionnaires is indicated in the appendix.

3.3. 5 Sampling Techniques and selection of respondents

Due to the nature and geographical orientation of the Greater Accra Region which has numerous active construction sites. The Ministry of Water Resources Works and Housing was the first point of call. Ahadzie (2007) pointed out that there are 2000 registered building

contractors in Ghana. Sixteen (16%) of these are located in the greater Accra region of Ghana. This study was conducted among the contractors with the Ministry of Water Resources Works and Housing certificate Available records at the ministry indicated that there are forty seven thousand 47,000 registered firms class of D1K1-D4K4 classification. Recent record at the Ministry of Works and Housing reveals that only seventy percent (70%) of these are on annual renew list. This means that there are thirty two thousand nine hundred (32,900). Using the assertion by Ahadzie (2007), sixteen percent (16%) of these are operating in the Greater Accra. Meaning five thousand two hundred and sixty four (5,264) are operating in the greater Accra region. Records at the issuing authority indicated that about seven to ten percent (7%10 %) of these are active. The active companies were used for the study, making the population 376.Kish (1965) formulas was used, which give a procedure for calculating

minimum sample size.

$$n = \frac{K}{1+K/N} \quad \text{.....Equation 1}$$

Where n=sample size

N=Population under study =376..... Equation 2

S=Maximum standard deviation in the population elements (total error =0.1 at a confidence level of 95%).

V=Standard error of sampling distribution, $V = 0.5$

P=Proportion of the population element that belong to the defined category .i.e. 0.5

$$S = P(1-P) = 0.5(1-0.5) = 0.5(0.5) = 0.25 \quad \text{.....Equation 3}$$

$V^2 = 0.5 = 0.5^2 = 0.0025$……Equation 4

Therefore: $K = \frac{S^2}{V^2} = \frac{0.25}{0.0025} = 100$

$$n = \frac{100}{1 + 100/376} = 65$$

Therefore sample size obtained was 65.

Purposive and Snowball sampling technique was used for selecting the respondents. This technique was used because *Erbil et al. (2010)* has indicated that, the purposive sampling technique allows the researcher to select the individual who have good knowledge on the subject of discussion.

3.3.6 Administration of Questionnaire

Considering cost, means of transportation to site, ease of access to site, availability of information, nature of site and type of data required, the various questionnaire were sent personally to respondents and other interested participants and this was done by hand delivery to construction work professionals such as project managers, architects, quantity surveyor, engineers, and project site supervisors and direct face to face interviews with labourers on site of the sample construction firm to answer. Copies of the questionnaires were accompanied with a cover letter. For each interview, the interviewee were first briefed with the purpose of the study and its expected duration. They were also assured that information received will be kept strictly and confidential. Errands was made to distribute these questionnaires even though some were collected the same day, others were given few days elapse before retrieving them from the respondents. In all, sixty five (65) questionnaires were sent and, forty (40) representing a

response rate of sixty one (61%) percent were received and thirty eight were valid for the analysis.

3.3.7 Data Analysis and Documentation

The data collected from the questionnaire survey was analysed using Microsoft Excel 2007 and Relative Importance Indices (RII) techniques used to rank the result. This RII technique has been used by Nesan (1997) and Holt et al. (1999) in the same context of application. The Relative Importance Index (RII) techniques calculation was based on the formula:

$$RII = \sum \frac{1_{n1} + 2_{n2} + 3_{n3} + 4_{n4} + 5_{n5}}{5(n_1 + n_2 + n_3 + n_4 + n_5)} \quad \text{Equation (5)}$$

Where n = the number of responded agreeing with the x choices. The computation of RI using the formula yield the value of RII ranging from point two to one where point two represent minimum strength and one the maximum strength, (Holt *et* al., 1996).

CHAPTER FOUR

ANALYSIS AND DISCUSSION OF RESULTS

4.1 INTRODUCTION

This chapter reports on the analysis of the research findings. The major topic in this chapter includes establishing guidelines to achieve standard labour out-put for concrete works in the Ghanaian construction industry during concrete production and placement, and the challenges associated with achieving this standard labour out-put on site. This analysis focuses on Ghanaian construction firms and not the rest of the professionals.

4.2 NARRATIVE OF DATA ACQUIRED

Out of a total of 60 questionnaires sent, 38 responded to the questionnaire which represents 63.33% participation. Table 4.1 shows the various component of this.

Table 4.1: Breakdown of various groups responded the Questionnaire

Group	**No. of Respondents**	Percentage %
Project manager	5	13.15
Architect	6	15.8
Construction Manager	4	13.5
Quantity surveyor	5	4.17
Civil Engineer	8	21.1
Site Supervisor	10	26.3
Total	**38**	**100**

From the Table 4.1 there are 4 Construction Manager representing 10.5 percent of the total respondents, 5 Quantity Surveyor which represents 13.15 percent of the total respondents, 5 Project Managers which also represents 13.15 percent of the total respondents, 6 Architect representing 15.8 percent of total respondent, 8 Civil Engineers representing 21.05 percent of total respondent and above all 10 Site Supervisors which representing 26.3 percent of the total respondents.

4.3 CHALLENGES TO ACHIEVING STANDARD LABOUR OUT PUT

To provide guidelines to achieve standard labour output, it is of importance to identify the challenges which affects contractors from achieving the standard output in the Ghanaian construction industry. With regards to this, (23) major challenges were identified and ranked according to their degree of contribution on a four point likert scale consisting of Very important, important, Somehow important and Less important. In effect, table 4.2 below gave the following results; delays to project inspection was deduced first with an RII of 0.56, frequent changes to design drawing, misunderstanding between labour were ranked second both with an RI1 of 0.49, low wages and dilution of supervision were ranked third with an RII 7 of 0.48. Motivation factors was ranked four with an R1I of 0.47, work load was ranked fifth with an R7 of 0.46. Deviation from plan was ranked sixth with an RII of 0.45, changing crew members was ranked seventh with an RII of 0.44, duplicated efforts and absenteeism were ranked eighth with an RII of 0.42.

Furthermore, in-competent supervision, mismanagement of time, equipment breakdown/inefficiencies poor lay out of work plan, poor weather condition, moral and attitude of workers, lack of information on target output were ranked ninth, tenth, eleventh and twelve with an RII of 0.41, 0.40, 0.37 and 0.36 respectively. And finally, materials and tools shortages,

proximity to materials, poor coordination, type of formwork and complexities and means of transportation of concrete was ranked thirteenth, fourteen, fifteenth and sixteenth respectively with an RII of 0.35, 0.34, 0.33 and 0.32.

The question stands that, what are the guide lines to overcome these challenge during concrete works on site?

Table 4.2: The challenges to achieving standard labour output in concrete works on site

Frequency Ranking→→from Very important → Less important

No.	**Challenges to labour output**	**1**	**2**	**3**	**4**	**Weighting**	**RII**	**Ranking**
1	Delays to project inspection	12	10	5	8	79	0.56	1st
2	Frequent changes to design drawing	9	19	7	0	68	0.49	2nd
3	Misunderstanding between labour	14	11	8	2	68	0.49	2nd
4	Low wages	12	10	8	2	67	0.48	3rd
5	Dilution of supervision	11	16	8	0	67	0.48	3rd
6	Motivation factors	12	16	6	1	66	0.47	4th
7	Work Load	10	20	5	0	65	0.46	5th
8	Deviation from Plan	14	15	5	1	63	0.45	6th
9	Changing crew members	15	14	6	0	61	0.44	7th
10	Duplicated efforts	14	18	3	0	59	0.42	8th
11	Absenteeism	17	12	6	0	59	0.42	8th
12	In competent supervision	19	12	2	2	57	0.41	9th
13	Mismanagement of Time	15	18	2	0	57	0.41	9th
14	Equipment breakdown/inefficiencies	19	14	3	0	56	0.4	10th
15	Poor lay out of work plan	18	14	2	1	56	0.4	10th
16	Poor weather condition	23	10	1	1	53	0.37	11th
17	Moral and attitude of workers	26	7	0	3	52	0.36	12th
18	Lack of information on target output	20	11	2	1	52	0.36	12th
19	Materials and tools shortages	22	11	1	1	51	0.35	13th
20	Proximity to materials	22	10	3	0	51	0.35	13th
21	Poor coordination	23	10	1	1	50	0.34	14th
22	Type of formwork and complexities	22	10	1	1	49	0.33	15th

23	Means of transportation of concrete	25	8	1	1	48	0.32	16th

With respect to the statistical data obtained from the questionnaire survey as indicated above, we can comfortably conclude that, delays to project inspection, frequent changes to design drawing, misunderstanding between labour, low wages and dilution of supervision are the *three* highly important challenges to achieving standard labour output to concrete production and delivering. The remain challenges are also equally important and must be critically examine since those also forms part of the challenges concrete production and placement.

4.4 STANDARD LABOUR OUTPUT FOR CONCRETE WORKS OBTAIN ON SITE

According to the information gathered during the questionnaire survey, there are five different concrete output obtain figures measured per hour and an optional space to specify if otherwise by the contractors in Ghana during concrete works on site. The data analysis regarding the use of these questionnaires is as follows; only one construction firm of the responded to have achieved a quarter *cubic of concrete per hour* representing 2.7%. No construction firm does an output of half *of a cubic of concrete per hour* representing zero percent of the total respondents, five companies out of the total firms achieve *1 cubic of concrete per hour* which represents 13.30% of the total respondents, fifteen construction companies according to the findings achieve an output of *1 ½ cubic of concrete per hour* which also represent 40.54% of the total respondents and also, fifteen companies out of the total thirty-eight respondents do achieve *2 cubic of concrete per hour* representing 40.54%. The space to be specified by the respondent gives a different value of five cubic of concrete per hour in all claiming representing 2.7% of the total respondents.

Therefore it can be deduced that majority of the construction firms, fifteen number out of the thirty eight respondents in Ghana according to the finding achieve *1 ½ cubic of concrete per hour* with a labour crew size of 14 number which constitute 2 *skilled* and 12 *unskilled* labour using 200 liters concrete mixer representing 40.54 percent, of the total contractors responded. Meanwhile, a total of fifteen construction confirm also confirms an out output of 2 cubic of concrete output per hour on site representing 40.57 percent of the total contractors responded using a 400liters of concrete mixer with a labour crew size of 14 number which constitute three *skilled* labour and eleven *unskilled*. The Table 4.3 below gives a detail data obtain from the questionnaire survey.

Table 4.3: Standard labour output for concrete works obtained from respondents on site

Concrete to labour Output	**Respondents according to output achieved on site**	
Various outputs	**No. of firms**	**Percentage achieved**
¼ of a cubic	1	2.7
½ of a cubic	0	0
1 cubic	5	13.5
1 ½ cubic	15	40.54
2 cubic	15	40.54
Specify others output cubic of concrete per hour	1	2.7
Total	**37**	**100**

In a reflection to the statistical data obtained from the questionnaire survey. We can comfortably conclude that fifteen out of the total of thirty-seven, construction firms achieved an output of concrete ranging between 1 ½ to 2 cubic of concrete per hour during concrete production and

placement on site with a total crew size of 14 labour force which constitute 2 to 3 *skilled* and 12 to 11 *unskilled* labour on site using between 200 to 400 liters capacity of concrete mixer in Ghana.

4.5 GUIDELINES TO ACHIEVING STANDARD LABOUR OUTPUT FOR CONCRETE WORKS ON SITE

After assessing the various output of contractors in concrete production and placement, the challenges which affects contractors from achieving the standard output in concrete works in the Ghanaian construction industry has also been identified, it‟s important to provide guidelines to achieve standard labour output during concrete works. With regards to thus, (13) major guidelines were identified and ranked according to their degree of contribution on a five point likert scale consisting of Highly important, Important, Quite important,

Unimportant and Highly unimportant. In effect, Table 4.4 gave the following results; Continuous flow of materials was deduced first with an R1 of 0.96, Setting Target for workers was ranked second an R1 of 0.95, Increase crew size was ranked third with an R7 of 0.92.

Minimized bottleneck to transportation of concrete was ranked four with an R1 of 0.91, Timely delivery of materials was ranked fifth with an R7 of 0.90. Meanwhile, Favorable weather condition was ranked sixth with an RI of 0.89, maintaining work discipline was ranked seventh with an RII of 0.88, maximum use of concrete mixer was ranked eighth with an RII of 0.87.

Furthermore, motivation of workers, resource labour with equipment, on time payment of workers and strict supervision were ranked ninth, tenth, eleventh and twelve with an RI of 0.86, 0.85, 0.84 and 0.82 respectively. And finally, realistic duration, avoid inspection during production of concrete was ranked thirteenth and fourteen respectively with an RI of 0.80 and 0.78.

Table 4.4 Guidelines to achieving standard labour output for concrete works.

		Frequency Ranking→→from highly unimportant → highly important							
No.	**Possible best practices**	**1**	**2**	**3**	**4**	**5**	**Weighting**	**RI**	**Ranking**
1	Continuous flow of materials	0	0	2	10	26	172	0.96	1st
2	Setting target for workers	0	0	2	9	27	171	0.95	2nd
3	Increase crew size in complex formwork	0	0	3	10	25	166	0.92	3rd
4	Minimize bottleneck in transportation of concrete	1	1	2	11	23	164	0.91	4th
5	Timely delivery of materials	0	2	2	10	24	162	0.90	4th
6	Favorable weather	0	0	5	10	21	160	0.89	5th
7	Maintaining work discipline	0	0	2	22	14	158	0.88	6th
8	Maximum use of concrete mixer	0	0	5	17	16	157	0.87	7th
9	Motivation to workers	0	0	5	18	15	154	0.86	8th
10	Resource labour with equipment	0	1	0	24	13	153	0.85	9th
11	On time payment of workers	0	2	5	17	14	151	0.84	10th
12	Strict Supervision	0	2	10	15	11	147	0.82	11th
13	Realistic Duration	0	1	9	15	11	144	0.80	12th
14	Avoid inspection during production of concrete	0	5	9	13	11	140	0.78	13th

With respect to the statistical data obtained from the questionnaire survey as indicated above, we can comfortably conclude that, continuous flow of materials, setting target for workers and increasing crew size in complex formwork are the *three* highly important practice to serve as a guideline in achieving standard labour output to concrete production and delivering. The remain practices are also equally important and must be considered as a back-up guidelines should the impact of the above three (*continuous flow of materials, setting target for workers and*

increasing crew size in complex formwork) listed practices are not felt then this can also be activated to enhance maximum efficiency of labour.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

Questionnaire is the first source in order to achieve the objectives. Beside, literature review also helps to achieve the objectives. Data analysis using relative index and frequently analysis was explained in chapter four. Overall, the objectives of the study were achieved. The following are the objectives that have been achieved.

iv. Identify the existing standard labour outputs for concrete works in the Ghanaian construction industry;

v. Identify the challenges faced by contractors in achieving standard labour outputs for concrete works; and vi. Develop the most appropriate guidelines for achieving standard labour outputs for concrete works.

5.2 REVIEW OF RESEARCH OBJECTIVES

The identification of the existing standard labour outputs for concrete works in the Ghanaian construction industry was achieved by the literature review. Moreover, the identification the challenges faced by contractors in achieving standard labour outputs for concrete works; was also achieved using the questionnaire with all the subsequent challenges which affect concrete production and delivering on site. Finally, the development of the most appropriate guidelines for achieving standard labour outputs for concrete works in the Ghanaian construction industry was achieved in the recommendation after administering questions to obtain the best possible practices in achieving standard labour output during concrete works.

5.3 CONCLUSIONS

From the study that was carried out, all the objective were achieved. The conclusions from the study are as follows;

a) **Objective 1**: **Identify the existing standard labour outputs for concrete works in the Ghanaian construction industry;**

From the study, the standard labour output to concrete production and placement identified was an output of 1½ to 2 cubic per hour using between 200 to 400 liters capacity of concrete mixers with a crew size of fourteen number which constitute the following listed below;

Table 5.1: Recommended Crew Size Distribution

Category of Crew	**No.**
Loaders	6No.
Mixer operator	1No.
Concrete conveyors to pouring site	4No.
Masons to placed concrete and tamp	2No.
Carpenter to fix opening formwork	1No.
Total Crew size	**14No.**

The main objective of achieving standard labour output is to enhance labour efficiency and reduced non-productive hours in other to maintain a realistic project costs which will further avoid unreasonable cost overruns. Managing labour output on site is necessary for all types of projects regardless of its location and magnitude. This is a practice in all construction firms according to our study. Achieving standard labour output is a practice that should be carried out for all types of construction project. This will enable project to be delivered successfully, within scope, budget and on time.

Objective 2: **To identify the challenges faced by contractors in achieving standard labour outputs for concrete works**

From the study, sixteen different types of challenges were identified namely:

a. Moral and attitude of workers;
b. Poor co-ordination of work ;
c. Materials and tools shortage
d. Proximity to materials ;
e. Frequent absenteeism;
f. Poor weather condition;
g. Time mismanagement ;
h. Lack of information to set target;
i. Deviation from design;
j. Poor layout of work plan;
k. Delays to project inspection;
l. Low wages;
m. Changing crew members;
n. Equipment breakdown;
o. In-competent Supervisor and
p. Complexity nature of formwork

Among these, Low wages, changing of crew members, equipment breakdown, complexity nature of work and in-competent supervisor were the five major challenges to nonachievement of standard labour output faced by contractors in Ghana during concrete works which are followed by poor weather condition, time mismanagement, lack of information to set target,

deviation from design, poor layout of work plan and delays to projection inspection. However, proximity to materials, moral and attitude of workers, poor co-ordination of work and materials and tools shortages are also challenges to achieving standard labour output faced by contractors in Ghana.

Objectives 3: **Developing the most appropriate guidelines for achieving standard labour outputs for concrete works.**

From the study, the fourteen main guidelines to achieving standard labour output in the Ghanaian construction industry were identified during questionnaire survey. These guidelines are listed and ranked as follows:

a. Continuous flow of materials;
b. Setting target for workers;
c. Increase crew size in complex formwork;
d. Minimize bottleneck in transportation of concrete;
e. Timely delivery of materials;
f. Favorable weather;
g. Maintaining work discipline;
h. Maximum use of concrete mixer;
i. Motivation to workers;
j. Resource labour with equipment;
k. On time payment of workers;
l. Strict Supervision;
m. Realistic duration and

n. Avoid inspection during production of concrete.

Among these identified guidelines, continuous flow of materials, setting targets for workers and increasing crew size in complex formwork are the *three* most important guidelines in achieving standard labour output to concrete production and delivering. Even though these guidelines are most important, the remaining practices are also equally important and must be considered.

5.4 RECOMMENDATIONS

In other to maximum labour productivity during concrete works, it is therefore strongly recommended that contractors should constantly study the guidelines identified in this study to maximize their labour output during concrete works on site. Contractors are also advised to attend refresher courses in construction labour management and organizational development to equip themselves with the requisite skills to transform their organizational set-up and manage labour effectively with flexibility since human resource management is considered as the most challenging aspect of project management.

Innovative way of achieving standard labour output is to developed a *work pack ticket* which is a sheet of paper designed by the site engineer outlining all the works to be carried out the following day including set targets and this should be discussed with the site supervisor and the foremen by identifying all the associated risk involved in executing the works, the means by which those risk can be mitigated. This is to avoid any waste of time on site when artisans have to stop mid-way during pouring concrete think about how best the works can be carried out. Foremen must be experienced and up to task to measure productivity on hourly basis, set targets and think through jobs before activating them.

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APPENDIX

MAIN QUESTIONNAIRE (For FINDING RELATIVE IMPORTANCE INDEX)

Please indicate by ticking the appropriate column the relative importance of each of the following. Kindly mark (√) to tick in any one column for each row of factor according to your experience.

SECTION 1: Background Information

1. *What classification of Ministry of Works* & Housing Water Resources class of contractors *does your company belong?*
   - ☐ D1K1
   - ☐ D2K2

- ☐ D3K3
- ☐ D4K4

2. Which of the following Construction Professional group do you belong?

- ☐ Project Manager
- ☐ Architects
- ☐ Construction Manager
- ☐ Quantity Surveyor
- ☐ Civil Engineer
- ☐ Site Supervisor

2. How long have you been practicing Construction?

- ☐ Less than 3 years
- ☐ 3 – 5 years
- ☐ 6-10 years
- ☐ Greater than 10 years

4. What is your area of specialty?

- ☐ Project Management
- ☐ Project Planning and Control
- ☐ Project Co-coordinating
- ☐ Quantity Surveying and Estimating

☐ Site Engineering

☐ Site Management

☐ Site Supervision

Challenges to achieving standard Labour output

5. Below are challenges to the achievement of standard labour output in concrete production. Rank on a Likert scale of 1-4 which of these perceived practices you consider important.

Challenges	***Very Important (1)***	***Important (2)***	***Somehow Important (3)***	***Less Important (4)***
Moral and attitude of workers				
Poor coordination				
Mismanagement of time				
Poor weather condition.				
Materials and tools shortages				
Lack of information on target outputs				
In competent supervisors.				
Motivational factors				
Deviation from plan				
Dilution of supervision				
Work overload				

Absenteeism				
Frequent changes to design drawings				
Proximity to materials				
Duplicated efforts				
Equipment breakdown /inefficiencies				
Poor lay out of work plan				
Changing crew members				
Misunderstanding between labour				
Inspection delays				
Low wages				
Means of transportation of concrete				
Type of formworks and complexities				

Standard Labour Output for Concrete Works Obtained On Site

6. What is the labour output per hour for concrete pour at your site during concrete works execution?

☐ ¼ of a cubic per hour

☐ ½ of a cubic per hour

☐ 1 cubic of concrete per hour

☐ 1 ½ cubic of concrete per hour

☐ 2 cubic of concrete per hour

☐ Other, Specify……

7. What is the minimum number of labour crew per pour?

☐ 8 No.

☐ 10 No.

☐ 12 No.

☐ 13 No.

☐ 14 No.

☐ 15 No.

☐ Other, specify……

8. What is the capacity of concrete mixer per pour?

☐ 80 liters

☐ 100 liters

☐ 200 liters

☐ 300 liters

☐ 400 liters

☐ 500 liters

☐ 800 liters

☐ Other, specify ……..

9 What is the minimum number of ***skilled artisans*** deploy to achieve the planned labour output during concrete pour daily?

☐ 1 No.

☐ 2 No.

☐ 3 No.

☐ 4 No.

☐ 5 No.

☐ Other, Specify …….

10. What is the minimum number of ***unskilled artisan*** deploy to achieve the planned labour out-put during concrete pour?

- ☐ 7 No.
- ☐ 8 No.
- ☐ 11 No.
- ☐ 12 No.
- ☐ 13 No.
- ☐ 14 No.
- ☐ 15 No.
- ☐ Other, specify…….

Guidelines to Achieving Standard Labour Output for Concrete Works

11. Below are the best possible practices in achieving labour output during concrete works. Rank on a Likert scale of 1-5 which of these practices you consider important.

Possible Best Practices	**Highly Unimportant (1)**	**Un important (2)**	**Quite Important (3)**	**Important (4)**	**Highly Important (5)**
Setting targets with labour					
Maintaining work discipline					
On time payment to workers					
Motivation to workers					
Maximum use of con.mixer					
Resourcing labour with equipment					
Strict supervision					
Motivation of workers					
Realistic duration					
Avoiding inspection during production of concrete					
Timely delivery of materials					
Continues flow of Materials					

Favourable weather					
Minimizing bottlenecks in transportation of concrete					
Increase crew size in complex formworks